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COLLINS

instruction book

Collins Radio Company Dallas emergency 214-996-5000

820D-1
AM Broadcast Transmitter

BROADCAST EQUIPMENT GUARANTEE

The equipment described herein is sold under the following guarantee:

a. Except as set forth in paragraph b. of this section, Collins agrees with Buyer to repair or replace, without charge, any properly maintained equipment, parts or accessories which are defective as to design, materials, or workmanship and which are returned in accordance with Collins instructions by Buyer to Collins factory, transportation prepaid, provided:
   1. Notice of a claimed defect in the design, materials or workmanship of the equipment manufactured by Collins is given by Buyer to Collins within five (5) years from date of delivery, with exception of rotating machinery such as blowers, motors, and fans whereby notice must be given by Buyer to Collins within two (2) years from date of delivery.
   2. Notice of a claimed defect in the design, materials or workmanship of the following described Collins manufactured equipment is given by Buyer to Collins within two (2) years from the date of delivery:

20V-3	26U-2	81M	172G-2	216C-2	313T-4	642A-2	820F-1	830D-1	830F-2A
26J-1	42E-7	144A-1	212H-1	313T-1	356H-1	786M-1	A830-2	830E-1	830H-1A
26U-1	42E-8	172G-1	212Z-1	313T-3	564A-1	820E-1	830B-1	830F-1	830N-1A

b. The above guarantee does not extend to other equipment, accessories, tubes, lamps, fuses, and tape heads manufactured by others which are subject to only adjustment as Collins may obtain from the supplier thereof.

c. Collins further guarantees that any radio transmitter described herein will deliver full radio frequency power output at the antenna lead when connected to a suitable load, but such guarantee shall not be construed as a guarantee of any definite coverage or range of said apparatus.

d. The guarantee of this section is void if:
   1. The equipment malfunctions or becomes defective as a result of alterations or repairs by others than Collins or its authorized service center, or
   2. The equipment is exposed to environmental conditions more severe than specified by Collins in equipment manuals.

e. NO OTHER WARRANTIES, EXPRESSED OR IMPLIED, INCLUDING WARRANTIES OF MERCHANTABILITY OR FITNESS FOR INTENDED PURPOSE, SHALL BE APPLICABLE TO ANY EQUIPMENT SOLD HEREUNDER.

f. THE FOREGOING SHALL CONSTITUTE THE BUYER'S SOLE RIGHT AND REMEDY UNDER THE AGREEMENTS IN THESE SECTIONS. IN NO EVENT SHALL COLLINS HAVE ANY LIABILITY FOR CONSEQUENTIAL DAMAGES, OR FOR LOSS, DAMAGE OR EXPENSE DIRECTLY OR INDIRECTLY ARISING FROM THE USE OF THE PRODUCTS, OR ANY INABILITY TO USE THEM EITHER SEPARATELY OR IN COMBINATION WITH OTHER EQUIPMENT OR MATERIALS, OR FROM ANY OTHER CAUSE.

g. The guarantees of this section and limitations thereon will also accrue to the benefit of any purchaser of Buyer's F.C.C. license, provided:
   1. Notice of the sale of the F.C.C. license is given by Buyer to Collins in writing within thirty (30) days after the consummation of said sale; and
   2. No greater rights are granted to the purchaser of Buyer's F.C.C. license than are granted herein to Buyer.

How to Return Material or Equipment If, for any reason, you should wish to return material or equipment, whether under the guarantee or otherwise, you should notify us, giving full particulars including the details listed below, insofar as applicable. If the item is thought to be defective, such notice must give full information as to nature of defect and identification (including part number if possible) of part considered defective. (With respect to tubes we suggest that your adjustments can be speeded up if you give notice of defect directly to the tube manufacturer.) Upon receipt of such notice, Collins will promptly advise you respecting the return. Failure to secure our advice prior to the forwarding of the goods or failure to provide full particulars may cause unnecessary delay in the handling of your returned merchandise.

ADDRESS:

Collins Radio Company
Customer Returned Goods, 412-023
1225 North Alma Road
Richardson, Texas 75080

INFORMATION NEEDED:

(A) Type number, name and serial number of equipment
(B) Date of delivery of equipment
(C) Date placed in service
(D) Number of hours of service
(E) Nature of trouble
(F) Cause of trouble if known
(G) Part number (9 or 10 digit number) and name of part thought to be causing trouble
(H) Item or symbol number of same obtained from parts list or schematic
(I) Collins number (and name) of unit subassemblies involved in trouble
(J) Remarks

How to Order Replacement Parts When ordering replacement parts, you should direct your order as indicated below and furnish the following information insofar as applicable. To enable us to give you better replacement service, please be sure to give us complete information.

ADDRESS:

Collins Radio Company
Service Parts, 412-024
1225 North Alma Road
Richardson, Texas 75080

INFORMATION NEEDED:

(A) Quantity required
(B) Collins part number (9 or 10 digit number) and description
(C) Item or symbol number obtained from parts list or schematic
(D) Collins type number, name and serial number of principal equipment
(E) Unit subassembly number (where applicable)

1 December 1967

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15 May 1968
1st Revision, 24 November 1970

COLLINS

instruction book

820D-1
AM Broadcast Transmitter

This Manual Includes:

AM Broadcast Transmitter 820D-1
AM Broadcast Exciter 310W-1

Printed in United States of America

Collins Radio Company | Dallas, Texas

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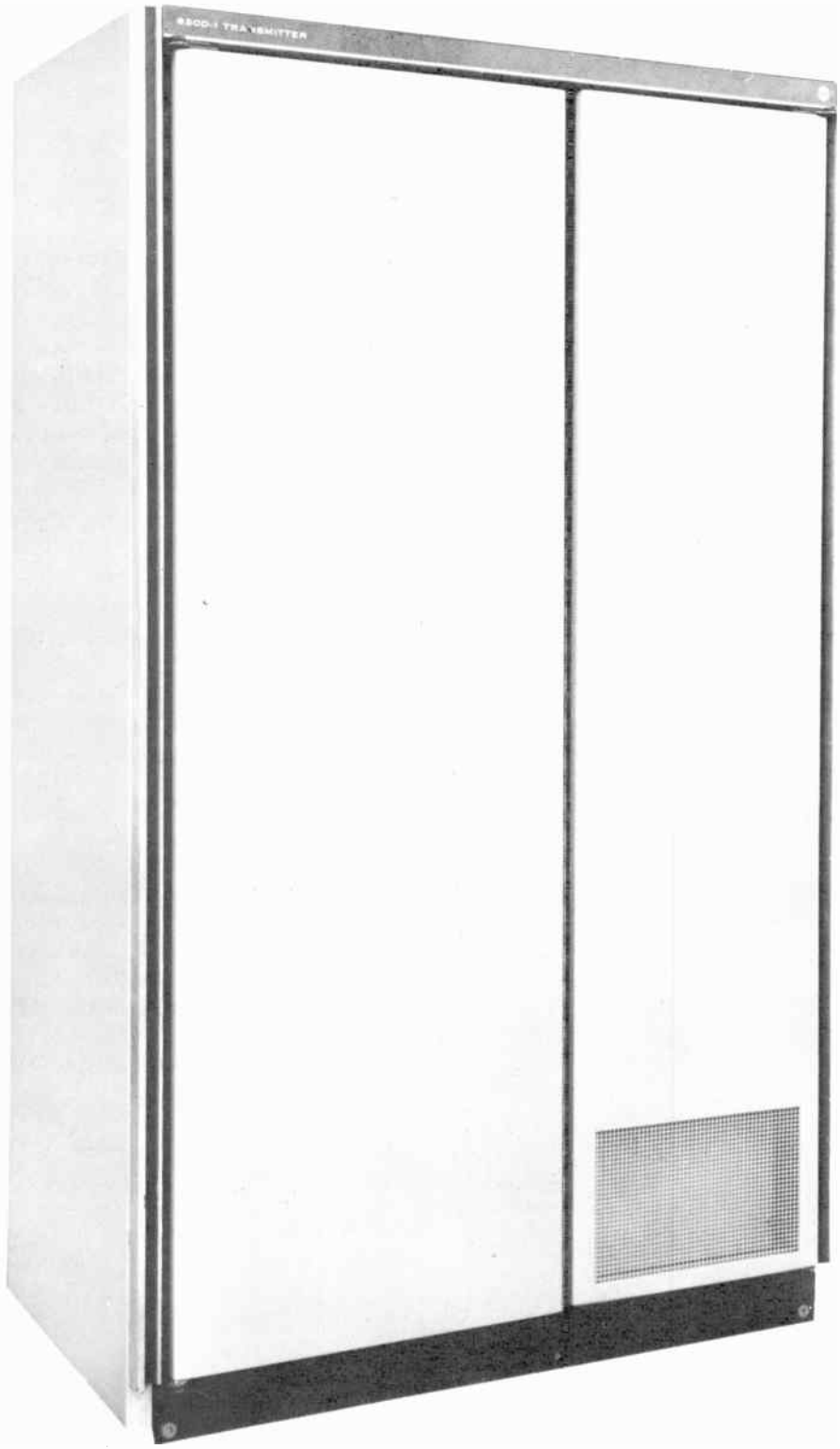


Figure 1-1. 820D-1 AM Broadcast Transmitter.

section 1
general description

1.1 INTRODUCTION

The 820D-1 AM Broadcast Transmitter is a high-fidelity, amplitude-modulated transmitter (figure 1-1) that operates in the frequency range from 540 to 1600 kHz with a nominal power output level of 0.25 to 1.1 kw. The frequency source of the 820D-1 is the 310W-1 AM Broadcast Exciter. Theory of operation and maintenance information for the 310W-1 are located in the unit instructions bound in the back of this manual.

1.2 PHYSICAL DESCRIPTION

The 820D-1 consists of a 2-bay Unistrut cabinet, an extended control panel, and an rf exciter (310W-1). The transmitter is designed for front access and may be installed with the rear panel against a wall. In the normal configuration, all components except the extended control panel are contained in the cabinet; however, the extended control panel may be mounted in the upper left bay (viewed from the front). In some installations, both the extended control panel and the 310W-1 are external to the cabinet. When external mounting for the 310W-1 is desired, the customer should specify the 19-inch mounting panel. The extended control panel mounts in a standard 19-inch equipment rack. Fifty feet of interconnecting cable for the extended control panel are provided. If desired, the cable length for both units may be increased to 250 feet. All meters, control devices, and indicators are located on the extended control panel.

The transmitter is divided into two major sections (figure 1-2). The left section contains the extended control panel, the output network, the screen supply, and the high-voltage power supply. The right section contains the power amplifier, modulator, rf driver, audio amplifier, control circuits, 310W-1 rf exciter, low-voltage power supplies, modulator transformer, and the modulator reactor. The output network is housed in a separate aluminum cabinet with a removable front cover. Access to the modulator, power amplifier, and rf driver is by a hinged access panel. A separate access is provided for the circuits in the card cage. Access to remaining circuits is provided by two access panels. The outer front doors are for appearance only.

The transmitter is cooled by two fans drawing air through a filter mounted in the lower right access panel. A portion of the air is picked up by a centrifugal blower used to cool the tubes. The remaining air is circulated by an axial fan and exhausted via grills in the output network enclosure. All air exhausts are in the top of the cabinet.

1.3 FUNCTIONAL DESCRIPTION

The 820D-1 consists of an rf exciter (310W-1), an rf driver, an audio driver, a modulator, a power amplifier, an output network, power supplies, and control circuits. An rf carrier from the 310W-1 is applied to the rf driver, which amplifies it to a level sufficient to drive the power amplifier. Audio from an external source is applied to the audio driver where it is amplified, then coupled to the modulator. From the modulator, amplified audio is coupled to the plate circuits in the power amplifier, modulating the rf carrier. An impedance-matching output network couples the modulated rf carrier from the power amplifier to a 50-ohm transmission line. For personnel protection, the access panels are equipped with control circuit interlock switches. In addition, each compartment in which high voltage is present is equipped with a spring-operated switch that grounds the high-voltage transformers and capacitors in that particular compartment. Overload protection is furnished by magnetic circuit breakers and a dc overload sensor circuit.

1.4 TECHNICAL CHARACTERISTICS

Frequency Range:
540 to 1600 kHz

Power Output:
1100 watts (550 or 275 watts reduced power)

Frequency Stability:
±5 Hz, 0° to +35°C (+32° to +95°F)
±10 Hz, -10° to +45°C (+14° to +203°F)
±20 Hz, -25° to +45°C (-13° to 203°F)

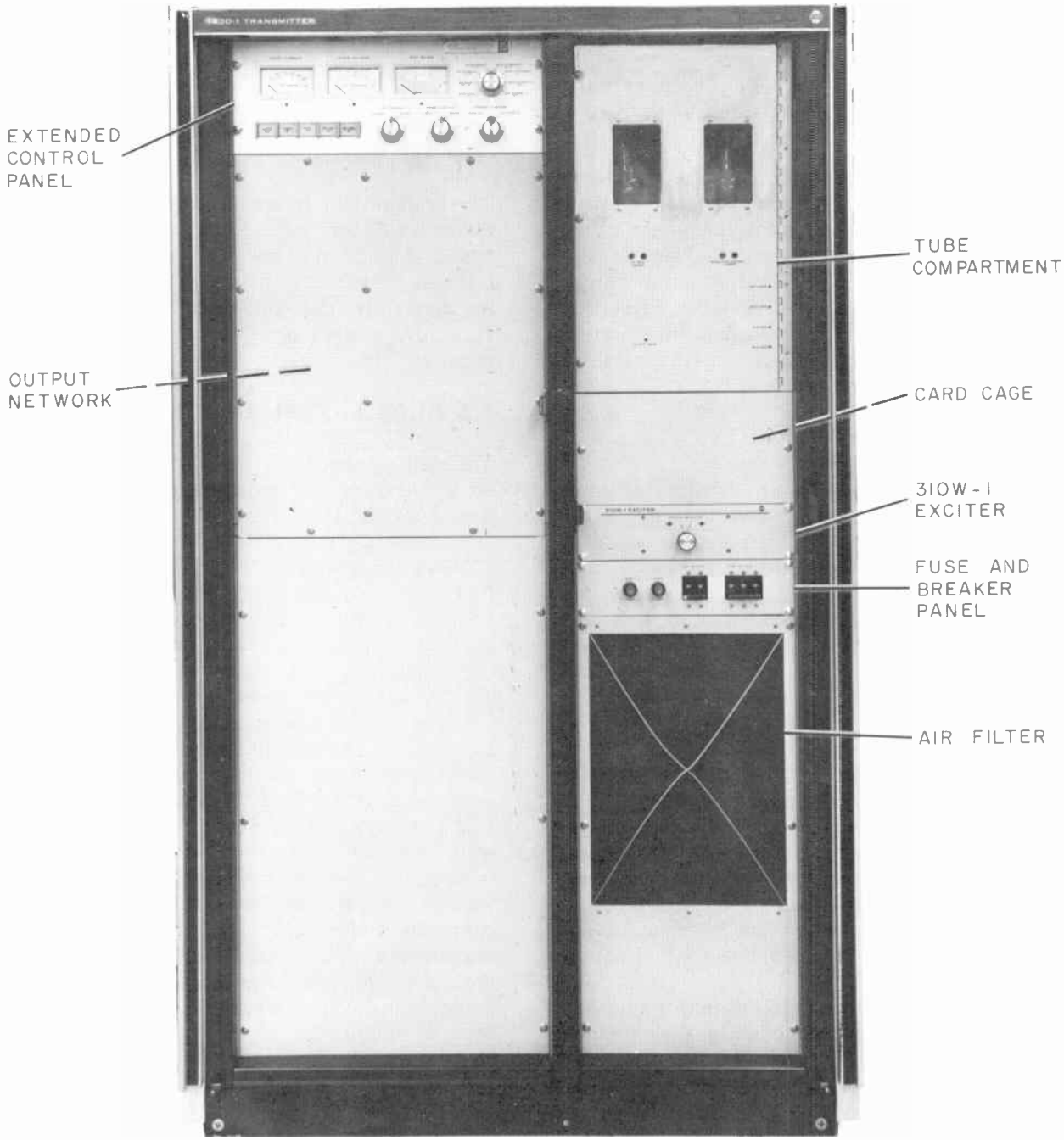


Figure 1-2. 820D-1 AM Broadcast Transmitter (Doors Removed).

Output Impedance:
50 ohms unbalanced (other impedances available on special order)

Audio Input Impedance:
600 ohms, balanced

Audio Input Level:
+10 dbm ±2 db

Audio Frequency Response:
±1 db, 100 to 7500 Hz and +2 db, 50 to 10,000 Hz, measured at 25, 50, 85, and 95% modulation

Audio Harmonic Distortion:
Less than 3%, 50 to 7500 Hz for 95% modulation

Carrier Shift:
Less than 3%, 0 to 100% modulation, 400 Hz reference

Residual Noise Level:
60 db below 100% modulation at 1000 Hz

Modulation Type:
High-level plate

Ambient Temperature Range:
-25° to +45°C

Ambient Humidity Range:
Up to 95%

Altitude Range:
Up to 7500 feet

Power Source:
208/230/240 volts, single-phase, 50/60 Hz

Combined Voltage Variation and Regulation Tolerance:
±5%

Power Requirement at 1100 Watts Output:

OPERATION	POWER INPUT (kw)	POWER FACTOR
Filaments on, carrier off	0.7	
Carrier on, no modulation	3.5	0.90
Carrier on, 100%, 1000 Hz mod.	4.4	0.90
Carrier on, average (30%) mod.	3.6	0.90

section 2
installation

2.1 GENERAL

Carefully inspect the shipping crates for signs of damage incurred during transit. If damage is found, contact the transportation company for further instructions. Do not throw away the shipping crates; the transportation company may want to inspect the crates. Refer to table 2-1 for a list of test equipment required for adjustment and maintenance of the transmitter.

2.2 UNPACKING

The transmitter 2-bay Unistrut cabinet is supplied in a skid-type crate. Cut and remove the steel straps from around the crate. Use a nail puller to remove the row of nails from the sides near the bottom of the crate. Lift the whole crate assembly (top and four four sides) from the base. Unbolt the cabinet from the base. Small components and tubes are packed in cardboard cartons. Normal care should be used in opening these packages. The high-voltage transformer T5, modulation transformer T1, modulation reactor L11, high-voltage filter inductor L12, and filament regulator T2 (if used) are each shipped in separate crates. Remove the top cover and four sides from each of these crates.

2.3 PREINSTALLATION

a. Place the control cable (A1W2), the RG-58C/U coaxial cable (A10W12), and the customer-furnished wires of groups B and C in the proper position (figure 2-1).

Note

The cables and wires can be brought into the transmitter cabinet either from the bottom or the top depending on customer facilities.

b. Connect one end of the customer-furnished, 4-inch wide ground strap to the station ground block.

c. Place the other end of the grounding strap in position for cabinet installation.

Table 2-1. Test Equipment Required.

ITEM	MANUFACTURER/MODEL (or equivalent)
Audio signal generator	Hewlett-Packard 206A
Dc power supply	Electro Products Lab Model EFB
Digital voltmeter	Hewlett-Packard 3430
Distortion and noise analyzer	Hewlett-Packard 334B
Modulation monitor	General Radio 1931 B or Metron 506 B
Volt-ohm-milliammeter	Triplett Model 630 N/A
Oscilloscope	Tektronix 545
Rf detector	Collins Radio 51-S
Rf impedance bridge	General Radio 1606A or 916AL
Rf load 50 + j0 2.5 kw	Bird (Water Cooled)
Rf signal generator	General Radio 1338H or Hewlett-Packard 606A
Vacuum tube voltmeter	Hewlett-Packard 412A or 425A
Resistor, 3350-ohm ±1%	Globar

2.4 ASSEMBLY

a. Place the cabinet in the desired location. Verify that the wires and cables (paragraph 2.3) are accessible when the cabinet is in position (figure 2-1).

Warning

Power must not be applied until the procedures in paragraphs 2.1 through 2.6.6 are completed.

b. Remove the lower left front panel from the cabinet for cable access from the bottom. Remove the top left panel for access from the top of the cabinet (if the alternate access is used).
c. Pull the control wires and cables (groups A, B, and C, figure 2-1) through the access in the bottom (or top) of the cabinet and route through the customer wiring duct on the rear wall of the cabinet.
d. Install extended control panel A1 in the customer-furnished equipment rack or console.
e. Remove lower right access panel and lower left access panel (if not previously removed).
f. Install transformers T5 and T1, voltage regulator T2 (if used), and inductors L11 and L12 in proper positions (figure 2-2). Secure the units with the hardware provided.
g. Set the power amplifier and modulator tubes aside for installation in paragraph 2.8.1.
h. Set capacitor C1 aside for installation in paragraph 2.8.1.
i. Remove output network access panel and top left access panel (if not previously removed).
j. Install capacitor C13 in the proper position but do not engage the shaft of B4 (power amplifier tuning motor) to C13 until instructed in paragraph 2.7.6.

Caution

Use care when installing the crystals. Rough handling may damage the crystals and prevent proper operation.

k. Remove the 310W-1 AM Broadcast Exciter from the cabinet.
l. Remove the top cover from the 310W-1 and install the two crystals (Y1 and Y2).
m. Replace the top cover of the 310W-1 and install the 310W-1 in the right section of the transmitter (figure 1-2).

2.5 WIRING

2.5.1 Component Wiring

Warning

Power must not be applied until the procedures in paragraphs 2.1 through 2.6.6 are completed.

a. Attach interconnecting wiring to the proper terminals on transformers T5 and T1, voltage regulator T2 (if used), and inductors L11 and L12 by matching the numbers on the wires to the terminals.
b. Attach interconnecting wiring to the proper terminals on capacitor C13.

2.5.2 Extended Control Panel A1

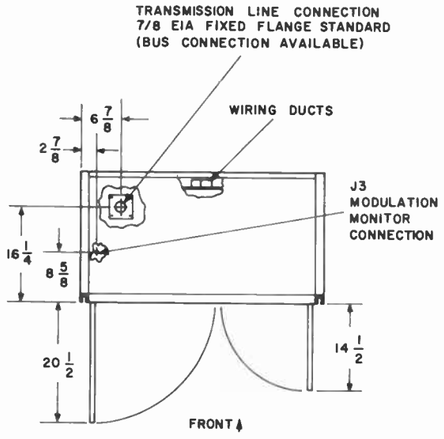
a. Connect one end of the 26-pair, shielded cable A1W2 to terminal board TB1 on the right wall of the left bay (figures 2-1 and 2-3).
b. Connect the other end of A1W2 to terminal board TB1 on the back of the extended control panel A1.
c. Use a jumper and ohmmeter to check that each wire connected to terminals of A1TB1 (panel A1) is connected to the matching terminal of TB1 in the transmitter cabinet.

2.5.3 310W-1 AM Broadcast Exciter

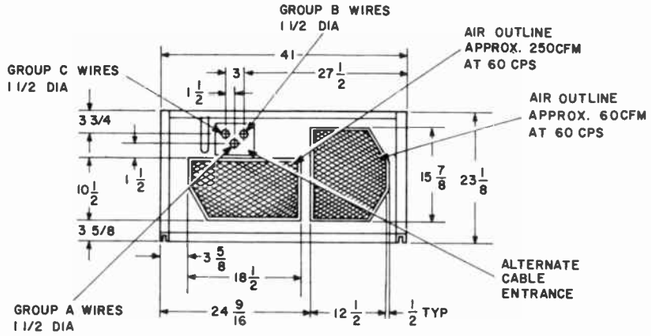
Verify the wiring of the 310W-1 using figures 2-1 and 2-4 and the schematic in the envelope inside the back cover of this manual.

2.5.4 Audio Input, Frequency Monitor, and Modulation Monitor

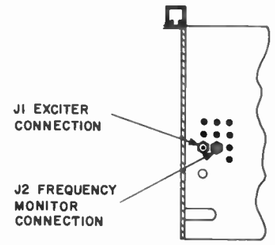
a. Connect one end of the shielded audio input cable to terminals 16, 17, and 18 of TB2 as shown in figure 2-4.
b. Connect the other end of the audio input cable to the customer-furnished equipment.
c. Connect one end of the customer-furnished frequency monitor cable (RG-58C/U) to J2



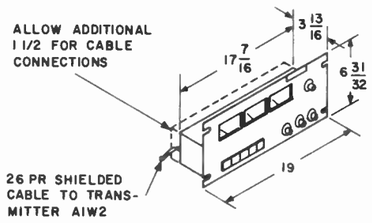
TOP VIEW



TOP VIEW

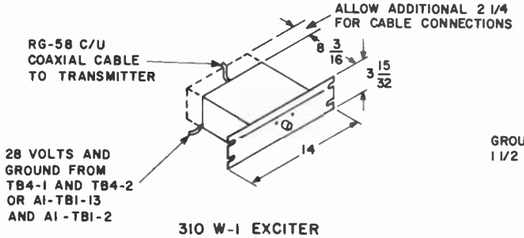


SECTION D-D



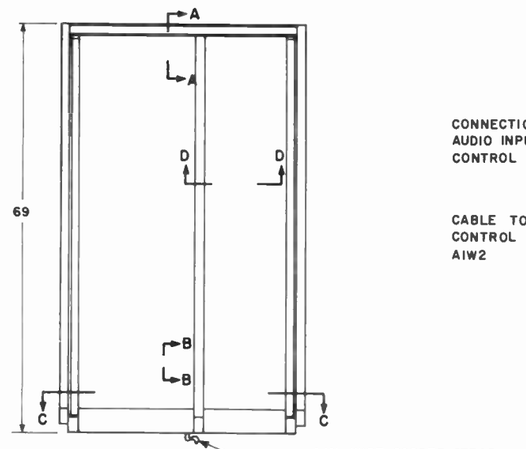
A1 UNIT - EXTENDED CONTROL PANEL

NORMALLY INSTALLED IN CUSTOMERS EQUIPMENT RACK OR CONSOLE; MAXIMUM CABLE LENGTH OF 250 FT.

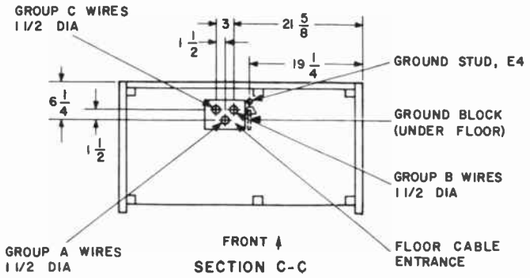


310 W-1 EXCITER
758-5207-003

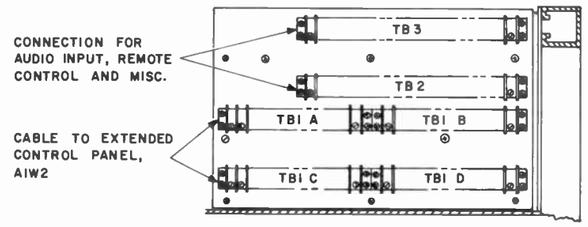
NORMALLY INSTALLED IN TRANSMITTER OR AT CUSTOMERS OPTION MAY BE INSTALLED IN EQUIPMENT RACK OR CONSOLE. MAXIMUM CABLE LENGTH OF 250 FT. (IF OPTION IS SELECTED SPECIFY CPN 758-5207-002)



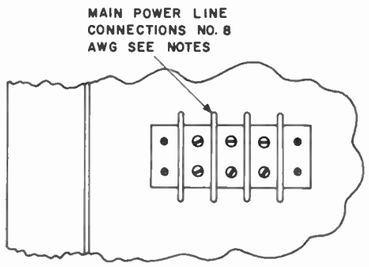
FRONT VIEW



SECTION C-C



SECTION A-A



SECTION B-B

NOTES:

1. GROUP A WIRES:
   26 PR SHIELDED CABLE TO EXTENDED CONTROL PANEL. 50 FT PROVIDED.
   RG-58 C/U COAXIAL CABLE TO EXCITER. 6 FT PROVIDED
2. GROUP B WIRES:
   AUDIO INPUT - TWISTED, SHIELDED PAIR CABLE, 22 AWG
   MODULATION MONITOR - RG-58 C/U COAXIAL CABLE
   FREQUENCY MONITOR - RG-58 C/U COAXIAL CABLE
   REMOTE CONTROL AND MISC. INTERLOCKS - MAX. OF 25 NO. 20 AWG WIRES (IF NEEDED)
   } BY CUSTOMER
3. GROUP C WIRES:
   208/230/240V, SINGLE PHASE, 3 WIRE POWER INPUT FUSED AT WALL DISCONNECT BOX (BY CUSTOMER) FOR 30A, 3 NO. 8 AWG WIRES
4. WEIGHT: 1100 LBS APPROXIMATE
5. ALL DIMENSIONS ARE IN INCHES UNLESS OTHERWISE SPECIFIED

Figure 2-1. Outline Dimensions and Installation Details.

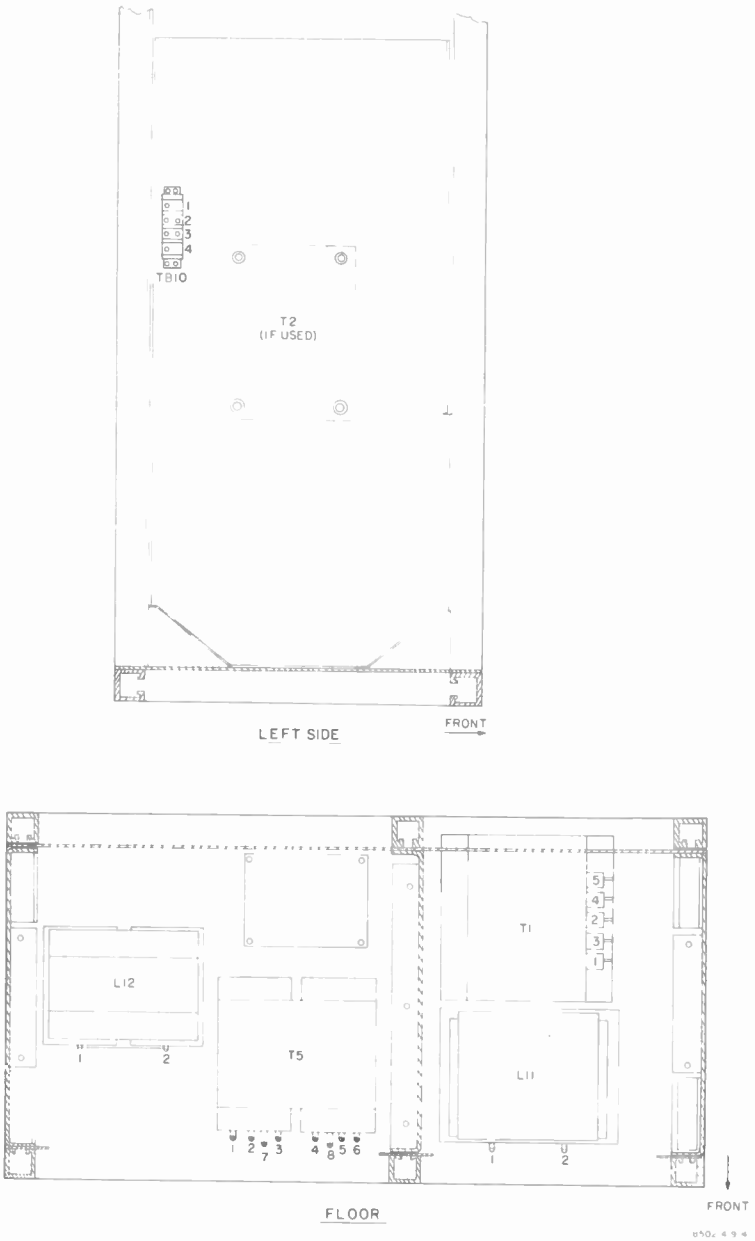


Figure 2-2. Component Installation Details.

(feed-through) on the bottom of the tube compartment (figure 2-1).

d. Connect one end of the customer-furnished modulation monitor cable (RG-58C/U) to J3 (feed-through) on top of the output network (figure 2-1).
e. Connect the remaining ends of the frequency and modulation monitor cables to the customer-furnished equipment.

2.5.5 RF Output Connection

a. Connect the rf coaxial cable (50-ohm) to the transmission line connector on top of the output network (figure 2-1). The transmission connector is a 7/8-inch Electronics Industries Association (EIA) flange. An optional bus connection is available.
b. Connect the other end of the coax to the antenna.

2.5.6 Remote Operation (Optional)

a. If remote control of the transmitter is used, remove the jumpers from terminals 1 and 2, 3 and 4, 5 and 6, 7 and 8, and 9 and 10 of TB3 on the right side of the top left section (figure 2-1).
b. Connect one end of the remote wires to the terminals of TB2 as shown in figure 2-4.
c. Connect the other end of the remote wires to the customer-furnished remote equipment.

2.6 INITIAL CHECKS

2.6.1 Visual Inspection

Warning

Power must not be applied until the procedures in paragraphs 2.1 through 2.6.6 are completed.

Inspect the equipment in the 820D-1 cabinet for loose components and/or connectors. Check carbon block arrestors (E1, E2, and E3) for proper installation. Check for frayed or damaged wiring.

2.6.2 Panel Interlocks Check

Check the output network, tube compartment, lower left, and lower right access panel interlocks for proper operation.

2.6.3 Power Supply Check

Check each power supply transformer primary tap for proper connection. Refer to table 5-4 for proper connections.

2.6.4 Transmitter Ground Check

a. Check that building power line ground is connected to transmitter ground terminal E4.
b. Using an ohmmeter, check for low resistance (not more than 1 ohm) between building power line ground and transmitter terminal E4.

2.6.5 Frequency Dependent Components Check

All frequency dependent components are selected and adjusted during factory test for the customer frequency. Check for installation of correct frequency dependent components as indicated in tables 5-2 and 5-3 in conjunction with figures 5-1 and 5-2. Refer to paragraph 5.6.15 for adjustment procedure for the output network.

2.6.6 Extended Control Panel Connections Check

Check for proper connections of the extended control panel at A1TB1 and TB1. Refer to figure 2-3.

2.7 CONTROL CIRCUIT OPERATION

2.7.1 Initial Power Connection

a. Provide a 208/230/240-volt, 3-wire, single-phase power source capable of providing 5 kw for the 820D-1.
b. Provide a primary disconnect (customer-furnished), fused for 30 amperes per line.

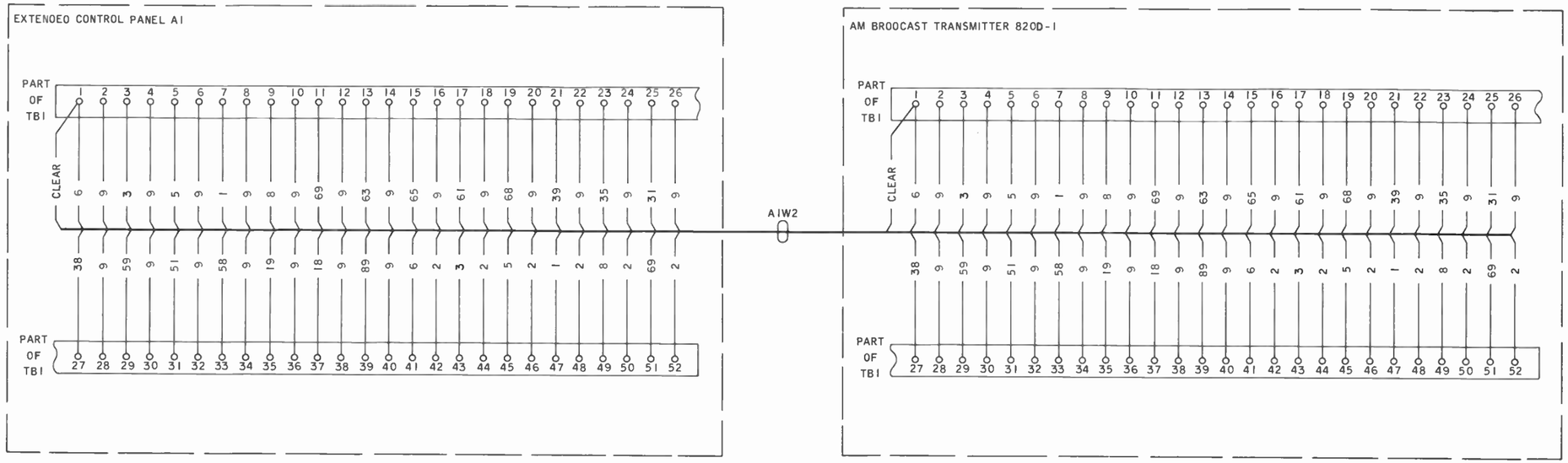
Warning

Open the primary disconnect switch and remove the fuses.

Caution

Verify that circuit breaker CB2 is open. Circuit breaker CB2 must not be closed until control circuit operational checks (paragraphs 2.7.1 through 2.7.7) are completed.

c. Open circuit breaker CB1.
d. Connect one end of the power cable to the primary disconnect switch terminals.
e. Connect the other end of the power cable to terminal board TB5-1, TB5-2, and TB5-3. Refer to figure 2-4.



NOTES:

1. THE FIRST NUMERAL INOICATES THE COLOR OF THE WIRE BOOY ANO THE SECOND NUMERAL INOICATES THE COLOR OF THE TRACER

COLOR COOE	
NUMBER	COLOR
0	BLACK
1	BROWN
2	RED
3	ORANGE
4	YELLOW
5	GREEN
6	BLUE
7	VIOLET
8	GRAY (SLATE)
9	WHITE

2. WIRES ARE CONNECTEO POINT TO POINT (FOR EXAMPLE: TBI-I CONNECTS TO AITBI-I, TBI-2 CONNECTS TO AITBI-2, ETC)

Figure 2-3. Extended Control Panel A1, Interconnecting Wiring Diagram.

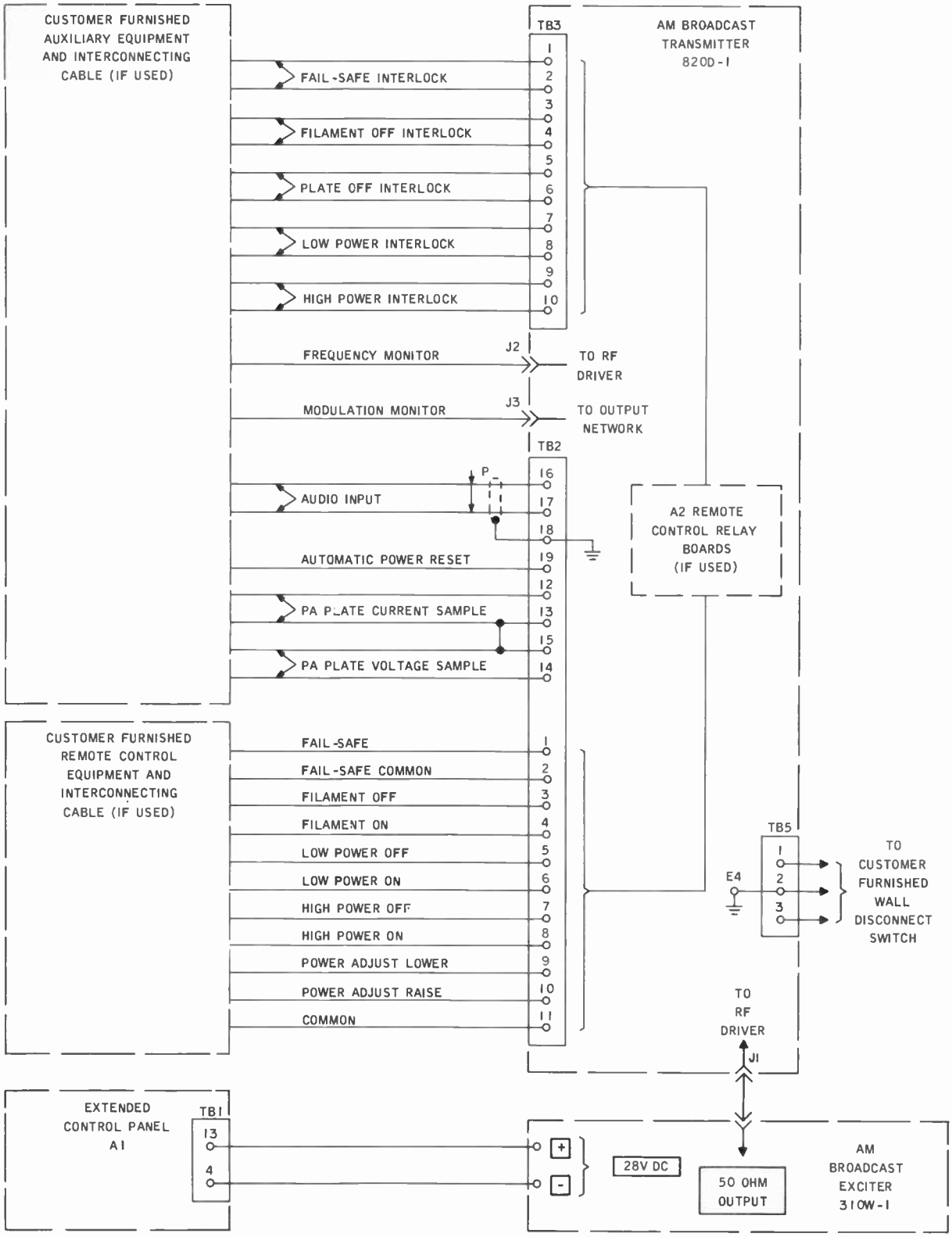


Figure 2-4. Customer-Furnished Auxiliary Equipment, Interconnecting Wiring Diagram.

f. Install fuses and close the primary disconnect switch.
g. Measure and verify proper line voltage.

2.7.2 Filament On

a. Close circuit breaker CB1. Note that FILAMENT OFF and PLATE OFF indicators light.
b. Set TEST METER function switch on the extended control panel to 28V SUPPLY V. Verify indication of +28 ±3.5 volts dc.
c. Open and close the tube compartment, output network, lower left, and lower right access panels in turn. Observe that opening each of the four panels causes the FILAMENT OFF indicator to go out.
d. Push FILAMENT ON pushbutton. Observe that the blower and fan operate.
e. After the blowers attain normal operating speed, note that FILAMENT ON indicator lights and FILAMENT OFF indicator goes out.

2.7.3 Filament Voltage Adjustment

a. Connect calibrated volt-ohm-milliammeter (vom) to A15E8 and A15E9.
b. Measure modulator filament voltage. Adjust R16 (modulator filament adjust), if necessary, for indication of 9.5 volts ac.
c. Connect calibrated vom to A15E6 and A15E7.
d. Measure power amplifier filament voltage. Adjust R15 (power amplifier filament adjust), if necessary, for indication of 9.5 volts ac.
e. Remove the vom.

2.7.4 Plate On

a. Verify that FILAMENT OFF indicator is lighted.
b. Push LOW POWER ON pushbutton. Observe that FILAMENT OFF and PLATE OFF indicators go out. Observe that FILAMENT ON and LOW POWER ON indicators light.
c. Push FILAMENT OFF pushbutton. Observe that FILAMENT ON and LOW POWER ON indicators go out. Observe that FILAMENT OFF and PLATE OFF indicators light.
d. Push HIGH POWER ON pushbutton. Observe that FILAMENT OFF and PLATE OFF indicators go out. Observe that FILAMENT ON and HIGH POWER ON indicators light.
e. Push FILAMENT OFF pushbutton. Observe that FILAMENT ON and HIGH POWER ON indicators go out. Observe that FILAMENT OFF and PLATE OFF indicators light.

2.7.5 Overload Circuit Adjustment

The overload circuit is adjusted during factory test and should not require any adjustment. However, if the overload circuit is not operating properly, perform the procedure in paragraph 5.6.10.

2.7.6 Tuning and Power Adjust Circuits

a. Verify that circuit breaker CB1 is closed.
b. Push FILAMENT ON pushbutton. Observe that FILAMENT OFF indicator goes out and FILAMENT ON indicator lights.
c. Set TEST METER function switch to PA GRID I position.
d. Adjust A11C3, PA GRID TUNING, for maximum grid current indication on the TEST METER.
e. Push FILAMENT OFF pushbutton and open circuit breaker CB1.
f. Manually turn the variable plates of capacitor C13 clockwise to the stop. Turn the variable plates back two turns (counterclockwise) from the stop.
g. Close circuit breaker CB1 and push HIGH POWER ON pushbutton. Observe that FILAMENT OFF and PLATE OFF indicators go out. Observe that FILAMENT ON and HIGH POWER ON indicators light.
h. Hold PA TUNING switch (A1S6) in RAISE position.
i. Verify that B3 (power amplifier tuning motor) turns clockwise to the stop. Release PA TUNING switch.
j. Push FILAMENT OFF pushbutton and open circuit breaker CB1.
k. Engage the B3 motor shaft to capacitor C13.
l. Verify that the mechanical stop on the shaft of motor B4 (power adjust motor) is angularly aligned with the contact on the variac (transformer T3).
m. Close circuit breaker CB1 and push HIGH POWER ON pushbutton. Observe that FILAMENT OFF and PLATE OFF indicators go out. Observe that FILAMENT ON and HIGH POWER ON indicators light.
n. Hold PA TUNING switch in LOWER position and observe that the shaft of motor B3 turns counterclockwise.
o. Hold PA TUNING switch in RAISE position. Observe that the shaft of motor B3 turns clockwise.

p. Release PA TUNING and observe that the switch returns to off.
q. Set POWER CONTROL switch (A1S9) to MANUAL.
r. Hold POWER ADJUST switch (A1S7) in RAISE position and observe that the shaft of motor B4 turns clockwise.
s. Hold POWER ADJUST switch in LOWER position and observe that the shaft of motor B4 turns counterclockwise.
t. Release POWER ADJUST switch and observe that the switch returns to off.

2.7.7 Remote Control (Optional)

If remote control is not used, verify that the straps on terminal board TB3 (between pins 3 and 4, 5 and 6, 7 and 8, and 9 and 10) are properly installed. Refer to figure 2-4.

If remote control is used, verify that the above mentioned straps are removed and that the remote control cards are properly installed. Check the operation with the customer-furnished remote control equipment.

2.8 FINAL CHECKS AND ADJUSTMENTS

2.8.1 Plate Supply Check

a. With the power amplifier and modulator tubes removed, set POWER CONTROL switch to MANUAL.
b. Use POWER ADJUST switch to set power adjust variac to midposition.
c. Close circuit breakers CB1 and CB2.
d. Push LOW POWER ON pushbutton and observe that the PLATE VOLTAGE meter (A1M2, on the extended control panel) indicates approximately 2250 volts for the 500-watt cutback version or approximately 1550 volts for the 250-watt cutback version.
e. Push HIGH POWER ON pushbutton and observe that the PLATE VOLTAGE meter indicates approximately 3200 volts.
f. Push FILAMENT OFF pushbutton and open circuit breakers CB1 and CB2.

Caution

When installing the power amplifier and modulator tubes, ensure that the tubes are properly seated in the tube sockets. After closing the snap lock on the air chimney, check that the air chimney fits flush against the tube.

g. Open the tube compartment access panel and install the rear power amplifier tube.
h. Install capacitor C1 and the front power amplifier tube.
i. Install the modulator tubes.
j. Close circuit breakers CB1 and CB2.

2.8.2 Full-Power Meter Readings

a. Push HIGH POWER ON pushbutton.
b. Using table 3-2 as a guide, record meter indications for unmodulated operation.
c. Record modulator current and output power indications at 1000 Hz, 100 percent modulation.
d. Observe that values reflect approximately the typical meter readings.

2.8.3 Reduced Power Meter Readings

a. Push LOW POWER ON pushbutton.
b. Repeat paragraph 2.8.2, steps b., c., and d.

2.8.4 Power Output

2.8.4.1 Power Adjust

a. Verify that the limit stops on motor B4 allow the power variac complete range adjustment.
b. Push HIGH POWER ON pushbutton.
c. Set POWER CONTROL switch to MANUAL.
d. Run POWER ADJUST switch through complete range and record output power at each extreme position.
e. Set output power to desired level (1.1 kw).
f. Push LOW POWER ON pushbutton.
g. Run POWER ADJUST through complete range and record output power at each extreme position.
h. Set output power to desired level for power cutback.

2.8.4.2 Servo Power Control (Optional)

If the servo power control is used, perform the following steps.

a. Verify or perform paragraphs 5.6.2.10 and 2.8.2.1 before proceeding.
b. Push FILAMENT OFF pushbutton.
c. Open circuit breakers CB1 and CB2 and momentarily ground A6R30-2.
d. Install digital voltmeter between A6R30-2 and ground.

e. Close circuit breakers CB1 and CB2.
f. Push LOW POWER ON pushbutton.
g. Adjust A6R28 (low power) for 0-millivolt indication on the digital voltmeter. Remove the digital voltmeter.
h. Record the antenna current.
i. Set POWER CONTROL to AUTOMATIC. Note that the shaft of motor B4 does not move and that antenna current does not change.
j. Set POWER CONTROL to MANUAL. Using POWER ADJUST, set antenna current to a lower value than recorded in step h.
k. Set POWER CONTROL to AUTOMATIC. Observe that antenna current returns to level recorded in step h.
l. Set POWER CONTROL to MANUAL. Using POWER ADJUST, set antenna current to a higher value than recorded in step h.
m. Set POWER CONTROL to AUTOMATIC. Observe that antenna current returns to level recorded in step h.
n. Push HIGH POWER ON pushbutton.
o. Adjust A6R29 (high power) for 0-millivolt indication on the digital voltmeter. Remove the digital voltmeter.
p. Repeat steps h. through m.

2.8.5 Audio Proof

a. Push FILAMENT OFF pushbutton.
b. Connect audio signal generator to audio input (see figure 2-4).
c. Connect distortion analyzer to J3 (modulation monitor output).
d. Push HIGH POWER ON pushbutton. Set output power at level desired (1.1 kw).
e. Set the audio signal generator for proper modulation at 95 percent.
f. Disconnect the modulation monitor from J3 and connect an oscilloscope to J3 (if desired). If the oscilloscope is used, employ the X10 isolation probe. The distortion analyzer is still connected to J3.
g. Determine audio distortion over the range of 50 Hz to 10 kHz at 95 percent modulation.
h. Connect the modulation monitor to J3. The distortion analyzer is still connected to J3.
i. Maintain 95 percent modulation for all frequencies over the range of 30 Hz to 10 kHz.
j. Normalize input levels with reference to 1 kHz.
k. Determine frequency response over range of 30 Hz to 10 kHz.
l. Determine carrier shift.
m. The transmitter is now ready for normal operation.

2.9 FREQUENCY CHANGE

If the transmitter operating frequency is changed, several transmitter components and component settings must be changed. The components are the crystal and some components in the rf driver, and in the output network. Table 5-2 lists the frequency determinate components of the rf driver. Figure 5-1 shows the method for changing components of the rf driver. Table 5-3 lists the frequency determinate components of the output network. Figure 5-2 provides information for changing components of the output network. Table 5-6 lists the Collins part numbers for crystals of various frequencies.

section 3
operation

3.1 GENERAL

The 820D-1 turn-on sequence is controlled by relays. Two types of turn-on are available. Operating controls on the transmitter are limited to CB1 (LOW VOLTAGE circuit breaker) and CB2 (HIGH VOLTAGE circuit breaker). All other operating controls are located on the extended control panel A1 and the 310W-1 AM Broadcast Exciter. Table 3-1 describes the function ot each control and indicator on the extended control panel (figure 3-1). Refer to the unit instructions bound in the back of this manual for functional description of the 310W-1 controls.

3.2 NORMAL TURN-ON PROCEDURE

a. Turn on the station exhaust fans (if used).
b. Verify that all interlocked access panels are closed.
c. Verify that fuse F1 is good and that it is properly installed.
d. Set CB1 and CB2 to ON. Note that FILAMENT OFF and PLATE OFF indicators light. If FILAMENT OFF and PLATE OFF fail to light, an access panel interlock is open or both indicators need to be replaced.
e. Set TEST METER function switch to 28V SUPPLY V. Note that 26 to 30 volts is indicated on TEST METER.
f. Verify that the CRYSTAL SELECTOR switch on the 310W-1 is set to the proper position.
g. Push FILAMENT ON pushbutton. Note that the blower and fan start running. When the blower and fan attain normal operating speed, observe that the FILAMENT OFF indicator goes out and that the FILAMENT ON indicator lights.
h. Push the HIGH POWER ON pushbutton. (If reduced power operation is desired, push LOW POWER ON pushbutton.) Note that the HIGH POWER ON indicator lights and the PLATE OFF indicator goes out.
i. Use TEST METER function switch to check for proper voltage and current indications on the TEST METER. (Allow 60 seconds warmup time.) Refer to table 3-2 for typical meter readings.
j. Note the indications on the PLATE CURRENT and PLATE VOLTAGE meters. Refer to table 3-2 for typical meter readings.
k. Note that rf line current is at the correct value (table 3-2). If adjustment is necessary set POWER CONTROL to MANUAL and adjust rf line current using POWER ADJUST. (If automatic function equipment is installed, set POWER CONTROL to AUTOMATIC and rf line current is adjusted automatically.)

3.3 ALTERNATE TURN-ON PROCEDURE

a. Perform paragraph 3.2, steps a. through e.
b. Push the HIGH POWER ON pushbutton. (If reduced power is desired, push the LOW POWER ON pushbutton.) Hold HIGH POWER ON depressed until blower and fan motors attain normal operating speed. Observe that the FILAMENT OFF and PLATE OFF indicators go out and that FILAMENT ON and HIGH POWER ON indicators light.
c. Perform paragraph 3.2, steps h. through j.

3.4 REDUCED POWER (CUTBACK) OPERATION

Changeover from full power to reduced power operation is accomplished automatically by pushing the LOW POWER ON pushbutton. After pushing the LOW POWER ON pushbutton observe that the HIGH POWER ON indicator goes out and the LOW POWER ON indicator lights. To go back to full power operation, simply push the HIGH POWER ON pushbutton.

3.5 SHUTDOWN PROCEDURE

3.5.1 Emergency Off

A complete shutdown of the transmitter is accomplished by setting the LOW VOLTAGE circuit breaker (CB1) to OFF. This action starts an automatic sequence that turns off the transmitter. To remove all voltage present in the cabinet, set both circuit breakers to OFF and disconnect the primary disconnect. The modulator and power amplifier tubes do not require additional cooling

Table 3-1. Extended Control Panel A1, Front Panel Controls and Indicators.

REFERENCE DESIGNATION (Figure 3-1)	CONTROL OR INDICATOR	FUNCTION
M1	PLATE CURRENT	Indicates power amplifier plate current.
M2	PLATE VOLTAGE	Indicates power amplifier plate voltage.
M3/S8	TEST METER and function switch S8	TEST METER, in conjunction with function switch S8, permits monitoring of various voltage and current levels in the transmitter.
S9	POWER CONTROL	Selects either manual or automatic operation of the power output control circuit. When set to MANUAL, the POWER ADJUST switch S7 controls the power output level. When set to AUTOMATIC, the power output level is controlled automatically.
S7	POWER ADJUST	Controls the power output level. This control is operative only when POWER CONTROL S9 is set to MANUAL.
S6	PA TUNING	Tunes the plate tank circuit of the power amplifier. The plate tank circuit is in the output network.
S5/DS5	HIGH POWER ON	S5: when pushed, automatically starts a sequence that sets the transmitter to full power mode of operation. DS5: lights when transmitter is in high power mode of operation.
S4/DS4	LOW POWER ON	S4: when pushed, automatically starts a sequence that sets the transmitter to the reduced power mode of operation. DS4: lights when transmitter is in the low power mode of operation.
S3/DS3	PLATE OFF	S3: when pushed, removes 28 volts from high- and low-power plate control circuits. This turns off the bias, screen, and high-voltage power supplies. DS3: lights when the low- and high-power relays are deenergized.
S2/DS2	FILAMENT ON	S2: when pushed, applies 28 volts to the filament control circuits. DS2: lights when the filament control circuit is energized.
S1/DS1	FILAMENT OFF	S1: when pushed, removes 28 volts from the filament control circuits. DS1: lights when the filament control circuit is deenergized.

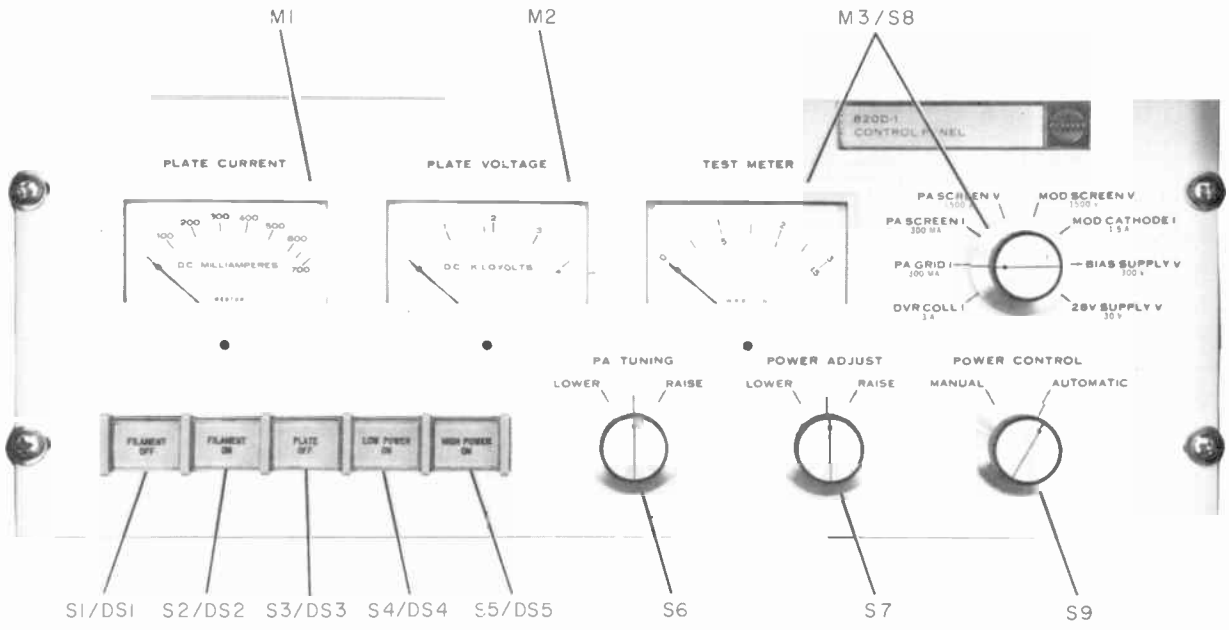


Figure 3-1. Extended Control Panel A1, Front Panel Controls and Indicators.

after power is removed; therefore, the fan and blower are automatically turned off.

3.5.2 Normal Turnoff

The transmitter is normally turned off by pushing the FILAMENT OFF pushbutton. After pushing the FILAMENT OFF pushbutton, observe that the HIGH POWER ON (or LOW POWER ON) and FILAMENT ON indicator go out and the PLATE OFF and FILAMENT OFF indicators light. If only the plate and screen voltage is to be turned off, refer to paragraph 3.5.3.

3.5.3 Plate Voltage Off

Removal of plate and screen voltage is accomplished by pushing the PLATE OFF pushbutton. After pushing the PLATE OFF pushbutton, observe that the HIGH POWER ON (or LOW POWER ON) indicator goes out and the PLATE OFF indicator lights. Also observe that the current and voltage indicated on the PLATE CURRENT and PLATE VOLTAGE meter drop to zero.

3.6 OVERLOAD RECYCLING

Dc overload is detected in the high voltage power supply. If overload exists, relay K3 (dc overload relay) is energized. Energizing K3 removes operating voltage from the bias, screen, and high voltage power supplies; thus removing bias, screen, and plate voltage from the modulator and power amplifier tubes. The HIGH POWER ON (or LOW POWER ON) indicator goes out and the PLATE OFF indicator lights. To restore power, push the HIGH POWER ON (or LOW POWER ON) pushbutton. If the overload condition persists, refer to maintenance instructions (section 5) for additional information.

3.7 NORMAL OPERATING VOLTAGES

Since the 820D-1 is operating properly, now is the time to record the normal operating voltages in table 5-5. Table 5-5 provides quick reference for proper normal operating voltages and can be used as a valuable aid in troubleshooting in the future.

Table 3-2. Typical Meter Readings.

POSITION OF FUNCTION SWITCH S8	FUNCTION	REDUCED POWER		FULL POWER
		550 w	275 w	1100 w
DVR COLL I	Rf driver collector current	2.5 amp	2.5 amp	2.4 amp
PA GRID I	Power amplifier grid current	80 ma	80 ma	80 ma
PA SCREEN I	Power amplifier screen current	140 ma	150 ma	115 ma
PA SCREEN V	Power amplifier screen voltage	690 volts	690 volts	680 volts
MOD SCREEN V	Modulator screen voltage	810 volts	800 volts	810 volts
MOD CATHODE I	Modulator cathode current (unmodulated)	150 ma	130 ma	200 ma
	(modulated 100%)	340 ma	240 ma	464 ma
BIAS SUPPLY V	Bias power supply voltage	-155 volts	-155 volts	-155 volts
28V SUPPLY V	28-volt dc power voltage	27 volts	27 volts	27 volts
METER	FUNCTION	REDUCED POWER		FULL POWER
		550 w	275 w	1100 w
PLATE CURRENT	Power amplifier plate current	338 ma	235 ma	480 ma
PLATE VOLTAGE	Power amplifier plate voltage	2200 volts	1550 volts	3100 volts
Auxiliary (connected to rf output coaxial cable)	Rf line current (unmodulated)	3.28 amp	2.32 amp	4.64 amp
	Rf line current (modulated 100%)	4.03 amp	2.84 amp	5.69 amp

section 4
principles of operation

4.1 GENERAL

The 820D-1 AM Broadcast Transmitter consists of an exciter, an rf driver, a power amplifier, an audio driver, a modulator control circuit, a modulator, power supplies, a constant voltage transformer (optional), tuning circuit, automatic power control circuit (optional), and other control circuits (figure 4-1). Paragraph 4-2 describes the functional relationships of the various circuits. Paragraphs 4-3 through 4-7 contain detailed circuit theory. During the following discussions, refer when necessary to the overall schematic diagram located inside the back cover of this manual.

4.2 BLOCK DIAGRAM DISCUSSION

Figure 4-1 is the block diagram of the 820D-1. The rf drive is a solid-state amplifier, Q1 and associated circuitry. A low-level rf signal, obtained from the 310W-1 AM Broadcast Exciter, is applied to the rf driver, amplified, and applied to the power amplifier. The rf signal is amplified in the power amplifier by two parallel-connected 5-500A tubes and is connected through the output network to a 50-ohm transmission line connection. Motor B3 turns the variable plates of capacitor C13 in response to tuning control signals from extended control panel A1. This tunes the output network. A high-level audio signal applied to the plate circuits of the two 5-500A tubes in the power amplifier modulates the rf signal. The audio signal that modulates the rf signal is obtained from an external source, is amplified by audio drivers A11Q1 through A11Q4, and is applied through the modulator control circuits to the modulator. The modulator, in conjunction with the modulation reactor, amplifies the audio signal to a level sufficient to modulate the power amplifier tubes.

The 208/230/240 volts ac is applied to the +28-volt power supply, the constant voltage transformer (optional), the filament supply, the bias supply, the screen supply, and the high voltage supply. The +28-volt dc power supply provides +28 volts dc to the audio driver, the 310W-1, and the rf driver and operates the control relays. The constant voltage transformer, if used, supplies regulated voltage to the filament supply. The filament supply provides 9.5 volts ac filament voltage to both the modulator and power amplifier tubes. The bias supply provides -155 volts dc fixed bias to both the modulator and power amplifier tubes. The screen supply provides +810 volts dc to the screen grids of the modulator tubes, +680 volts dc to the power amplifier screen grids, and +290 volts dc to the last two audio driver collectors. The high voltage supply provides 3200/2250/1550 volts dc to the modulation reactor and the plates of the modulator and power amplifier tubes. Dc overload is sensed in the high voltage circuit and, when an overload condition is detected, the overload relay removes +28-volt dc control from the relays that control the high voltage supplies. The 820D-1 power output is controlled by varying the high voltage. In manual operation, the high voltage is adjusted, by means of power adjust motor B4 in conjunction with buck-boost adjust transformer T3, by control signals from the extended control panel or remote control relay module (optional). In automatic operation, the power control sensor and power control servo amplifier, both optional, control the high voltage automatically. The control relays control all of the above mentioned power supplies except the +28-volt dc power supply. The control relays receive control signals from the extended control panel or the remote control relay module (optional).

4.3 RF CIRCUITS

4.3.1 General

The rf section of the 820D-1 consists of the 310W-1 AM Broadcast Exciter, an rf driver, a power amplifier, an output network, and a tuning control circuit. Circuit operation is discussed in paragraphs 4.3.2 through 4.3.5. Circuit operation of the 310W-1 is described in the unit instructions bound in the back of this manual.

4.3.2 RF Driver

The rf driver is a solid-state class C amplifier consisting of Q1 (TA-2669) and associated components. A low-level rf signal is transformer-coupled from the 310W-1 to the base of A11Q1. A11Q1 amplifies the rf signal and connects it to the power amplifier via a transformer with a tuned secondary.

4.3.3 Power Amplifier

The power amplifier is a class C amplifier consisting of two paralleled 5-500A tubes (V1 and V2) and associated components. An rf signal from the rf driver tank circuit is applied to the grid circuit of V1 and V2, amplified, and connected to the output network.

The driver tank circuit is a parallel resonant network that is adjusted for maximum grid current. The frequency monitor sample is derived from the tank coil. The power amplifier is neutralized by a bridge network in conjunction with fixed capacitors C1 and C4.

A combination of fixed and drive bias is used in the power amplifier. The fixed bias prevents excessive plate current in case drive voltage is lost.

Modulation of the rf signal is obtained by conventional plate modulation. Screen self-modulation is achieved via dropping resistors R7, R3, and R4.

4.3.4 Output Network

The output network is a 3-node bandpass filter using fixed-tuned components except for the input tuning capacitor. The filter consists of three tank circuits tuned to the fundamental frequency. The first tank circuit consists of capacitor C13, applicable capacitors C14 and C15 (table 5-2 for applicable capacitors and values), and inductor L6. The second tank circuit consists of inductor L7 and applicable capacitors C16 and C17. The third tank consists of applicable capacitors C18 and C19, and inductor L9. Inductor L8 provides fixed plate loading of the power amplifier. An rf sample of modulation monitoring is obtained from inductor L15.

The filter matches the plate impedance of the power amplifier to the 50-ohm transmission line and provides harmonic attenuation and a symmetrical bandpass.

Motor-driven variable vacuum capacitor C13 plate tunes the power amplifier. Capacitor C13 is controlled from the extended control panel A1.

The Q of the network plus the series-blocking capacitor prevents plate current dips from occurring at the point of maximum power output (unity power factor) during plate tuning. Therefore, it is necessary to adjust the network for the best efficiency at the particular point of power output. However, after C13 has been properly set, pa tuning remains unchanged for the cutback power mode. POWER ADJUST may be varied slightly to achieve exact output level with power change. If the automatic power output option is used, power adjustment will occur automatically.

4.3.5 Power Amplifier Plate Tuning

Power amplifier plate circuit tuning is accomplished by a motor-driven capacitor located in the output network (paragraph 4.3.4). Setting A1S6 (PA TUNING) to LOWER applies +28 volts dc through contacts of A1S6, through contacts of A7K2 to relay A7K1. Relay A7K1 energizes, applying 208/230/240 volts ac from TB8 pin 2 through contacts of A7K1, through TB8 pin 4 to the motor B3. Motor B3 runs turning capacitor C13 variable plates counterclockwise, increasing the capacitance. Releasing A1S6 removes 28 volts from relay A7K1, which deenergizes, stopping B3. Setting A1S6 to RAISE applies 28 volts dc through contacts of A1S6, through contacts 5 and 4 of A7K1 to relay A7K2. Relay A7K2 energizes, applying 208/230/240 volts ac from TB8 pin 2 through contacts 7 and 9 of A7K2, through TB4 pin 5 to the motor B3. Motor B3 runs, turning capacitor C13 variable plates clockwise, decreasing the capacitance. Releasing A1S6 removes 28 volts dc from relay A7K2, which deenergizes, stopping B3.

4.4 AUDIO CIRCUIT

The audio circuit consists of an audio driver, a modulator control, a modulator, and associated components. Audio is routed from an external source through the input attenuator and coupling transformer A3T1 to the solid-state amplifier of the audio driver. Resistors A3R1 through A3R5 form a fixed H-pad attenuator which provides a minimum isolation of 6 db from the source. Resistors A3R6, A3R7, and A3R8 are switched into the circuit by audio input relay A3K1 during reduced power operation. This action equalizes the audio drive level between high power and low

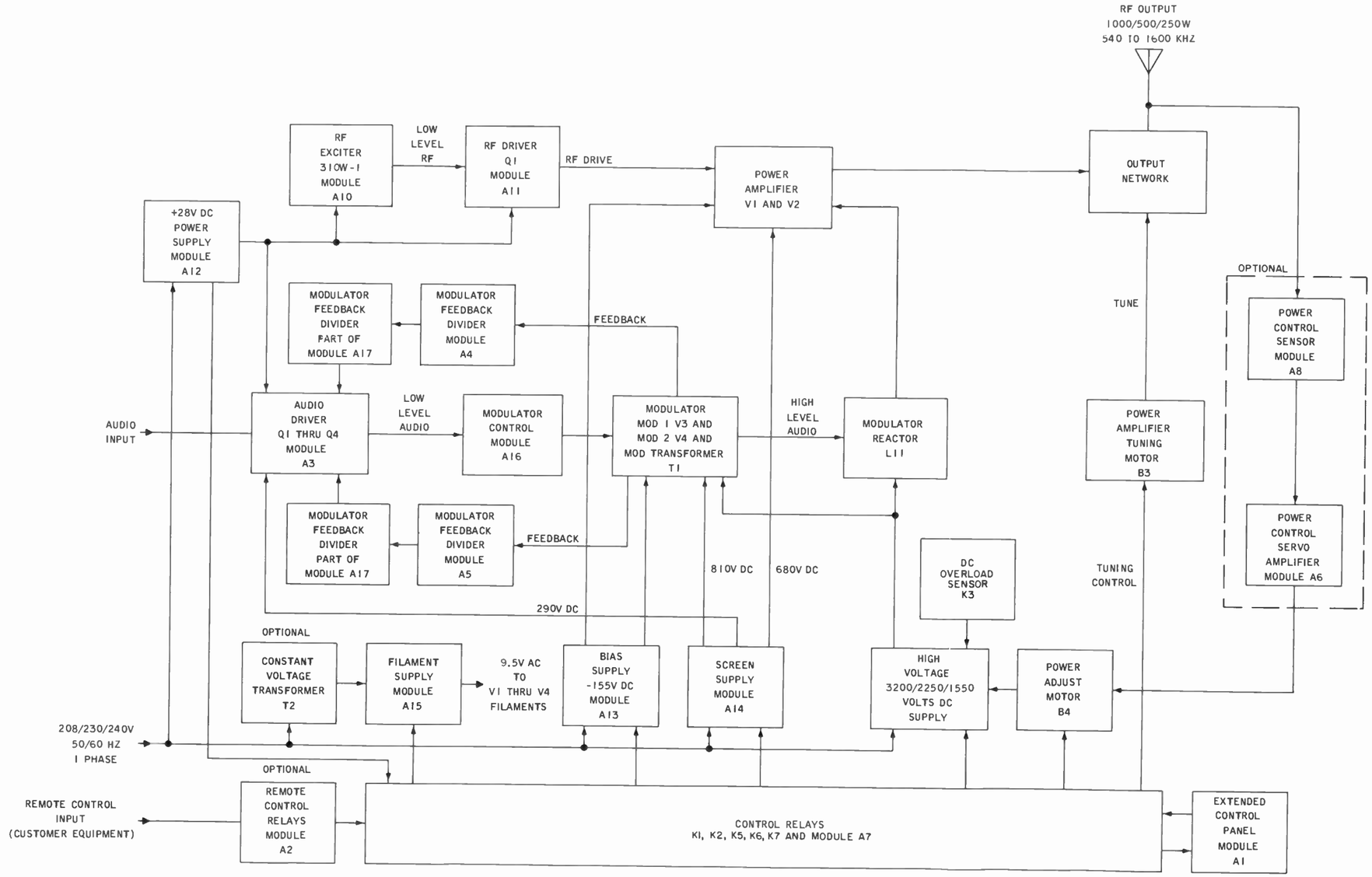


Figure 4-1. 820D-1 AM Broadcast Transmitter, Functional Block Diagram.

power operational modes. The audio driver amplifier is a class A push-pull amplifier. The amplifier, A3Q1 through A3Q4, amplifies the audio to a level sufficient to drive the modulator. The high-level modulator consisting of vacuum tubes V3 and V4 connected in push-pull, and operating class AB_1 amplifies the audio and connects it through a modulation transformer reactor circuit to the power amplifier (paragraph 4.3.3). Individual controls are provided to adjust the modulator fixed-bias for the desired level of unmodulated static cathode current in each tube. Controls are also provided to adjust the filament voltage and the dynamic balance of the grid drive. Frequency response is improved by applying negative feedback from the plates of V3 and V4 to the secondary circuit of A3T1. The transmitter power output is changed during cutbacks by reducing the power amplifier and modulator plate voltage.

4.5 POWER SUPPLIES

4.5.1 General

The 820D-1 contains a +28-volt dc power supply, a bias power supply, a high-voltage power supply, a screen power supply, and a filament power supply. Dc power supply outputs are monitored by meters located on extended control panel A1.

The output network panel, the tube compartment panel, the lower right panel, and the lower left panel are provided with interlocks. Opening any one of the four panels disables the filament, bias, screen, and high-voltage power supplies. Switches S8, S9, and S7 are grounding switches for the tube compartment, lower right, and lower left panels respectively. Opening any of these panels shorts all high voltage circuits to ground through the applicable switch.

4.5.2 +28-Volt DC Power Supply

The +28-volt dc power supply is a filtered full-wave rectified power supply. The power supply provides operating voltage for the control circuits, the audio driver, the indicator lamps, and the 310W-1 AM Broadcast Exciter. Single-phase, 208/230/240-volt ac power is coupled through low voltage circuit breaker CB1 and transformer A12T1 to a full-wave rectifier consisting of four diodes. The output of the rectifier is filtered and applied to the appropriate circuits.

4.5.3 Bias Power Supply

The bias power supply, a filtered full-wave rectifier, provides bias for the modulator and power amplifier tubes. Single-phase, 208/230/240-volt ac power is applied through high-voltage circuit breaker CB2, through buck-boost transformers T3 and T4, through fuse F1 and transformer A13T1 to full-wave rectifier A13CR1. The output of the rectifier is filtered by A13L1, A13C1 and A13C2. A13CR2 and associated circuitry suppresses transients, thus protecting the diodes in the rectifier. From the filter network, the -155-volt dc output connects to the grid circuits of the modulator and power amplifier tubes. The -155 volts dc supplies protective bias in case drive voltage is lost.

The output network panel, the tube compartment panel, the lower right panel, and the lower left panel are provided with interlocks. Opening any one of the four panels disables the bias power supply. Switches S8, S9, and S7 are grounding switches for the tube compartment, lower right, and lower left panels respectively. Opening any of these panels shorts all high voltage circuits to ground through the applicable switch.

4.5.4 High Voltage Power Supply

The high-voltage power supply provides plate voltage to the modulator tubes and the power amplifier tubes. The power supply is a full-wave rectifier with a resonant L-section filter. The tank circuit (L12 and C29) is tuned to the ripple frequency. Single-phase, 208/230/240-volt ac power is applied through high-voltage circuit breaker CB2, through the buck-boost transformers T3 and T4, through contacts of K6 or K5 (high-power or low-power mode respectively), and transformer T5 to the full-wave rectifier, CR1 through CR4. The output of the rectifier is filtered by the resonant L-section filter, comprised of L12, C29, and C30, and is applied to the plates of the modulator and power amplifier tubes. The low-power mode is achieved by reducing the plate voltage. Energized contacts of relay K5 select the applicable taps of transformer T5. The 820D-1 power output is controlled by varying the plate voltage. This is accomplished by a buck-boost transformer and a motor controlled buck-boost variable transformer. The motor is controlled by POWER ADJUST (A1S7) on the extended control panel. If the power control sensor and servo

amplifier (optional equipment) are used, the motor is controlled automatically from the servo amplifier when POWER CONTROL (A1S9) is set to AUTOMATIC.

4.5.5 Screen Power Supplies

4.5.5.1 General

The modulator and power amplifier screen power supplies receive operating voltage from the dual secondary windings of transformer A14T1. Single-phase, 208/230/240-volt ac input to the primary of A14T1 is connected from HIGH VOLTAGE CB2 through K6 or K5 contacts, through buck-boost transformer A14T1. The power supplies are similar, but not identical; therefore they are discussed separately in paragraphs 4.5.5.2 and 4.5.5.3.

4.5.5.2 Modulator Screen Power Supply

Single-phase ac voltage is coupled from the secondary of transformer A14T1 (terminals 7 and 8) to full-wave rectifier A14CR2. The rectifier output (approximately 810 volts dc) is filtered by A14L3, A14L4, A14C5, and A14C6; the filtered output is applied to the modulator screen grids. A14CR4 and associated circuitry suppresses transients, thus protecting the diodes in the rectifier. The filtered +290 volts dc for the final stage of the audio driver amplifier is supplied by A14CR5, A14CR6, and associated circuitry. Modulator screen voltage metering is supplied to the extended control panel A1.

Opening one of the four interlocked panels (paragraph 4.5.3) disables the screen supplies and (with the exception of the output network panel) shorts all high-voltage circuits to ground through the associated grounding switch.

4.5.5.3 Power Amplifier Screen Power Supply

Single-phase ac voltage is coupled from the secondary of transformer A14T1 (terminals 5 and 6) to full-wave rectifier A14CR1. The rectifier output (approximately 680 volts dc) is filtered by A14L1, A14L2, A14C3, and A14C4; the filtered output is applied to the power amplifier screen grids. A14CR3 and associated circuitry suppresses transients, thus protecting the diodes in the rectifier. Power amplifier screen voltage metering is supplied to the extended control panel A1.

Opening one of the four interlocked panels (paragraph 4.5.3) disables the screen supplies and (with the exception of the output network panel) shorts all high voltage circuits to ground through the associated grounding switch.

4.5.6 Constant Voltage Transformer (Optional)

The constant voltage transformer, if used, provides a regulated input to the filament power supply.

4.5.7 Filament/Cathode Circuits

The filament power supply provides filament voltage of 9.5 volts ac for the modulator and power amplifier tubes. The constant voltage transformer T2, if used, provides the ac input to separate transformers A15T2 and A15T1. If transformer T2 is not used, the ac input is provided from low-voltage circuit breaker CB1, through contacts of K2 to separate transformers A15T2 and A15T1. Resistor R16 (modulator filament adjust) allows adjustment of the voltage applied to the modulator filament transformer A15T2, and resistor R15 (power amplifier filament adjust) allows adjustment of the voltage applied to power amplifier filament transformer A15T1. The output of each transformer connects to the respective filament circuit. The filament chassis also contains metering circuits for modulator cathode current, power amplifier plate current, power amplifier grid current, and power amplifier screen current.

4.6 CONTROL, PRIMARY POWER DISTRIBUTION, AND OVERLOAD CIRCUITS

4.6.1 General

The control circuit consists of relays, momentary pushbutton switches, and interlock devices. Two method of turn-on are available. Application of primary power, for both methods of turn-on, is controlled by circuit breakers and relay contacts. The dc overload circuit provides protection for the high-voltage circuits from voltage surges. Refer to figure 4-2 as needed during the discussions in paragraphs 4.6.2 through 4.6.5. In the discussions, the low-voltage circuit breaker CB1, the high-voltage circuit breaker CB2, and all interlocks are considered closed.

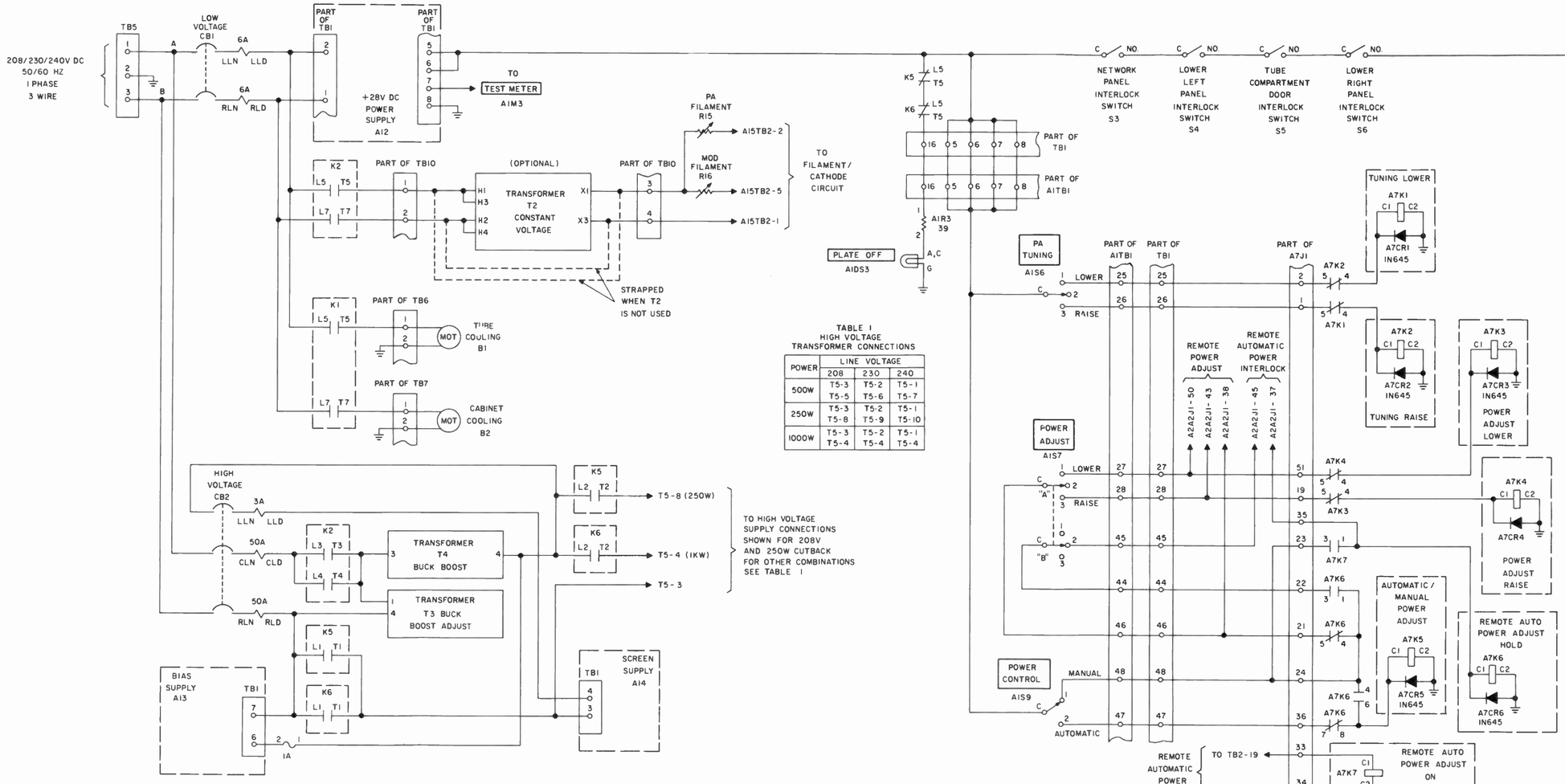


TABLE I
HIGH VOLTAGE
TRANSFORMER CONNECTIONS

POWER	LINE VOLTAGE		
	208	230	240
500W	T5-3 T5-5	T5-2 T5-6	T5-1 T5-7
250W	T5-3 T5-8	T5-2 T5-9	T5-1 T5-10
1000W	T5-3 T5-4	T5-2 T5-4	T5-1 T5-4

Figure 4-2. Control Circuits, Simplified Schematic (Sheet 1 of 2).

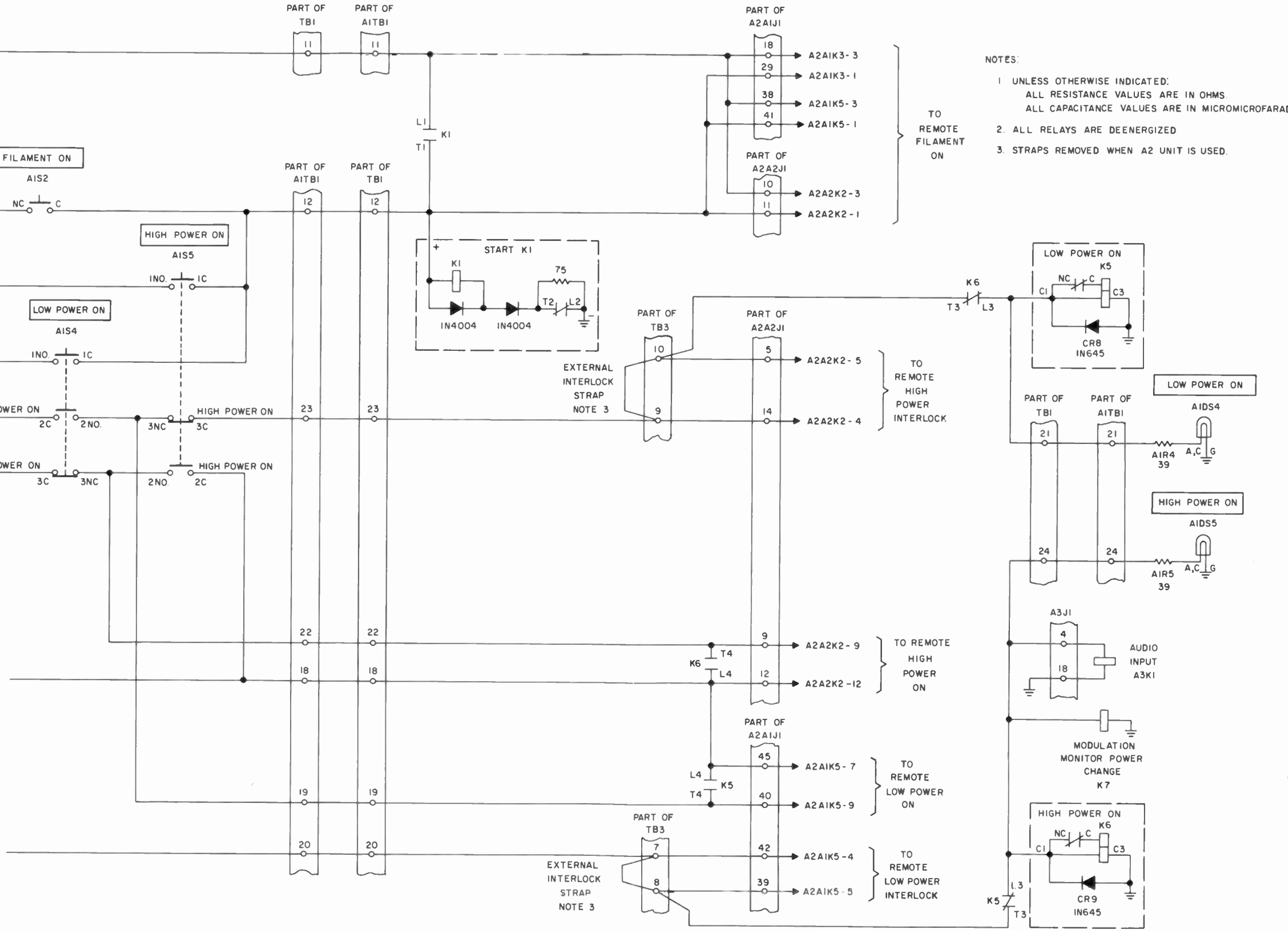
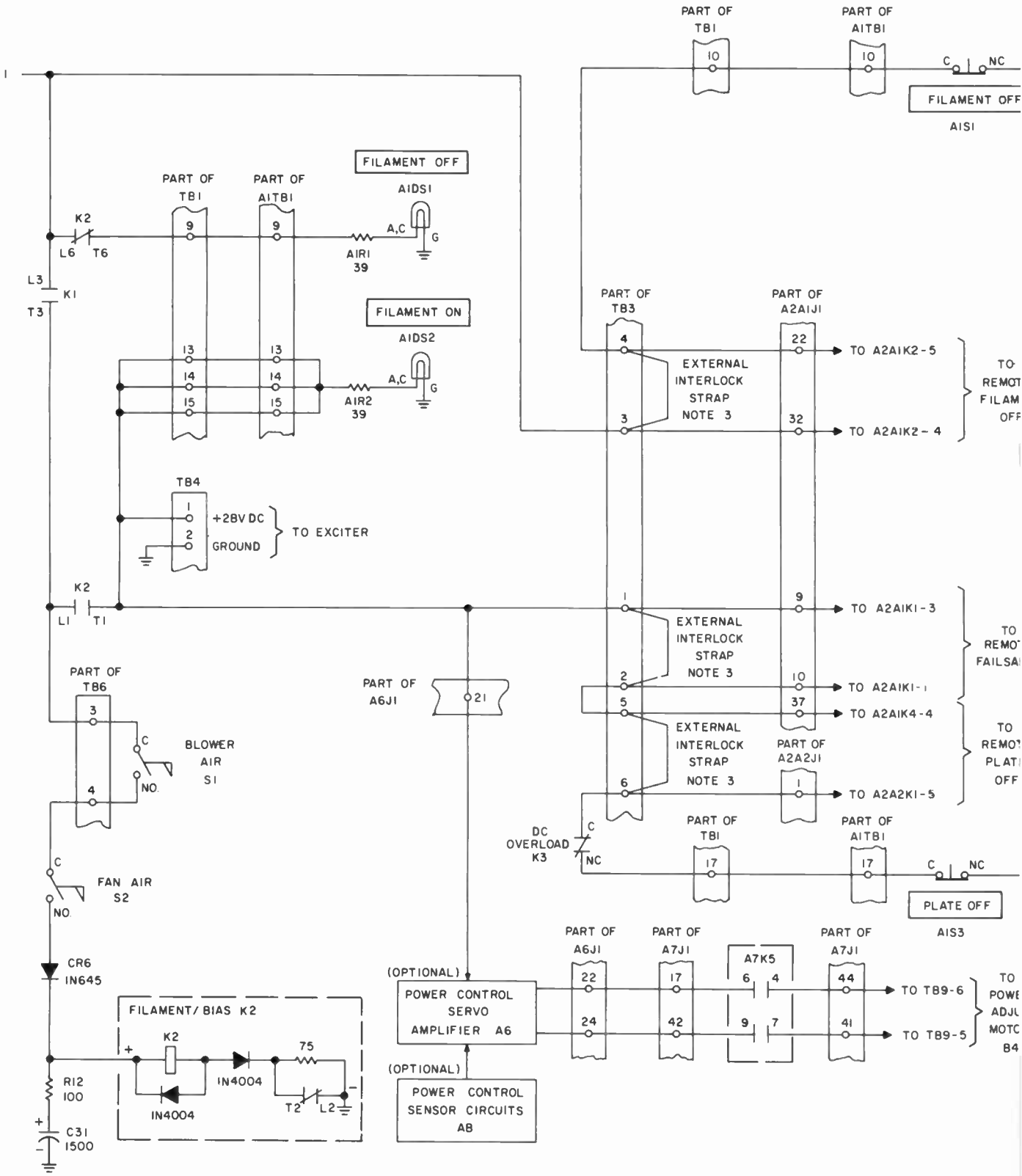


Figure 4-2. Control Circuits, Simplified Schematic (Sheet 2 of 2).



4.6.2 Normal Turn-On Operation

4.6.2.1 General

Normal method of turn-on consists of pushing two pushbuttons in sequence. The first pushbutton, FILAMENT ON switch (A1S2), controls relays that apply operating voltage to the 310W-1 AM Broadcast Exciter, the first two stages of the audio driver, the blower motors, and the filament power supply. The second pushbutton, HIGH POWER ON switch (A1S5) or LOW POWER ON switch (A1S4), controls relays that apply operating voltage to the bias, screen, and high-voltage power supplies. The second pushbutton also controls relays that connect audio attenuation, plate supply voltage, and modulation monitor taps for the desired configuration.

4.6.2.2 Filament Voltage Control Circuit

Pushing FILAMENT ON applies 28 volts dc from the 28-volt power supply through door interlock switches (S3 through S6), through FILAMENT OFF switch (A1S1), through FILAMENT ON switch to start relay (K1). Relay K1 energizes, applying 28 volts through the holding contact L1, T1, keeping K1 energized after A1S2 is released. (Relay K1 can be deenergized by pushing A1S1, which opens the 28-volt line.) Energized contacts of K1 provide operating voltage to blower motors B1 and B2, causing them to run. When B1 and B2 attain their normal operating speed, S1 (blower air switch) and S2 (fan air switch) close. The 28 volts is applied through energized contacts of K1, through closed switches S1 and S2 to filament/bias relay K2. Relay K2 energizes, applying 28 volts to the 310W-1 AM Broadcast Exciter through energized contact L1, T1 of K2. Capacitor C31, in conjunction with resistor R12 and diode CR6, prevents K2 from deenergizing during intermittent operation of the air switches (S1 and S2) caused by turbulence in the air flow. Relay K2 energized contact L6, T6 removes 28 volts from A1DS1 (FILAMENT OFF indicator). A1DS1 goes out. Power is applied through energized contact L1, T1 of K2 to A1DS2 (FILAMENT ON indicator). A1DS2 lights. Energized contacts of K2 provide operating voltage through constant voltage transformer, if used, through individual adjustable resistors to modulator filament transformer (A15T2) and power amplifier transformer (A15T1). From the transformer, filament voltage is applied to the respective circuits.

4.6.2.3 High-Power Control Circuit

The 28 volts dc for the low- and high-power control circuits is applied from energized contact L1, T1 of K2 (filament bias relay) through the normally closed contact of K3 (dc overload relay), through normally closed contact of switch A1S3 (PLATE OFF) to contact C2 of switches A1S4 (LOW POWER ON) and A1S5 (HIGH POWER ON). Pushing A1S5 applies 28 volts through closed contact C2, NO2 of A1S5 through normally closed contact NC3, C3 of A1S4, through K5 normally closed contact T3, L3 to K61 (high power on). Relay K6 energizes, applying 28 volts through holding contact L4, T4 of K6 to keep relay K6 energized after A1S5 is released. Power is also applied to high power relay (A6K1) in the power control servo amplifier (if used), relay A3K1 in the audio driver, relay K7 (modulation monitor power change relay), and to A1DS5 (HIGH POWER ON indicator). A1DS5 lights. If the power control servo amplifier is used, relay A6K1 switches R29 (high power adjust) into the automatic power output control circuit. Relay A3K1 energizes, switching the low-power attenuation pad out of the audio input circuit. Relay K7 energizes, providing high-power monitoring through contact R3, R1 to output jack (J3). Energized contact L5, T5 of K6 removes 28 volts from A1DS3 (PLATE OFF indicator). A1DS3 goes out. Energized contacts of K6 apply operating voltage to the bias, screen, and high voltage power supplies. When K6 energized, normally closed contact T3, L3 opened, preventing relay K5 from being energized while K6 is energized.

4.6.2.4 Low-Power Control Circuit

Operation of the low-power control circuit is similar to the operation of the high-power control circuit with the following exceptions. Pushing A1S4 (LOW POWER ON) removes 28 volts from relay K6, deenergizing K6. This removes power from relay A6K1 in the power control servo amplifier (if used), relay A3K1 in the audio driver, relay K7, and A1DS5 (HIGH POWER ON). A1DS5 goes out. Removing power from A3K1 switches the low-power pad into the audio input circuit. Removing power from K7 and A6K1 actuates the low-power mode configuration for modulation monitoring and output power control (if used). Deenergizing K6 applies power to A1DS3 (PLATE OFF indicator) and removes operating voltage from bias, screen, and high-voltage power supplies. A1DS3 lights. Power is applied through contact C2, N02 of A1S4, through contact NC3, C3 of A1S5, through K6 contacts to relay K5 and to A1DS4 (LOW POWER ON indicator). A1DS4 lights.

Relay K5 energizes, applying 28 volts through holding contact L4, T4 of K5 to keep relay K5 energized after A1S4 is released. Energized contacts of K5 apply operating voltage to the bias, screen, and high-voltage power supplies. When K5 energizes, normally closed contact T3, L3 opens, preventing relay K6 from being energized while K5 is energized.

4.6.3 Alternate Turn-On Operation

The alternate method of turn-on of the 820D-1 is performed by pushing either HIGH POWER ON switch (A1S5) or LOW POWER ON switch (A1S4). Pushing A1S5 or A1S4 performs the same function as described in paragraph 4.6.2.3 and applies 28 volts dc to energize relays K1 and K2. The sequence of operation is the same as that described in paragraphs 4.6.2.2 and 4.6.2.3. With either mode of operation the control circuits sequence properly, applying first filament and bias voltage and then plate and screen voltages. The only delay during transmitter turn-on is the length of time required for the blower motors to attain normal operating speed. Switch A1S5 or A1S4 must be held until PLATE OFF indicator goes out to complete the alternate method of turn-on for the 820D-1 transmitter.

Normal turn-off of the 820D-1 is done by pushing FILAMENT OFF switch (A1S1). Pushing A1S1 removes 28 volts dc from relay K1. Deenergizing relay K1 removes control voltage from relays K2, K5, K6, and K7 and operating voltage from the blowers, the 310W-1, and the filament, bias, screen, and high-voltage supply.

4.6.4 Plate-Off Control Circuit

Plate and screen voltages are removed from the modulator and power amplifier tubes by pushing switch A1S3 (PLATE OFF). For this discussion, the transmitter is considered operating in the high power mode. Pushing A1S3 removes 28 volts from relays K6 and K7. Deenergizing K6 removes 28 volts from relays A3K1 and A6K1 (if used) and the operating voltage from the bias, screen, and high-voltage power supplies. Thus, this action removes bias, screen, and plate voltage from the modulator and power amplifier tubes. The HIGH POWER ON indicator goes out and PLATE OFF indicator lights.

4.6.5 Output Power Control Circuit

4.6.5.1 General

For this discussion, the transmitter is considered operating in the high power mode. Manual and automatic control of output power are available. Automatic control requires additional optional equipment (power control sensor and power control servo amplifier). Plate voltage controls the output power level. Motor-driven buck-boost adjust transformer T3 adjusts plate voltage to maintain the desired output power level.

4.6.5.2 Manual Power Adjust

Setting A1S9 (POWER CONTROL) to MANUAL applies 28 volts through contacts of A1S9 to normally open contact 3 of A7K7 (remote auto power adjust on relay), to normally open contact 1 of A7K6 (remote auto power adjust hold relay), and through normally closed contacts of A7K6 to contact C of A1S7 (POWER ADJUST). Holding A1S7 in LOWER applies 28 volts through A1S7, through normally closed contacts 5 and 4 of A7K4 (power adjust raise relay) to A7K3 (power adjust lower relay). Energizing A7K3 applies operating voltage through energized contacts of A7K3, through normally closed contacts 8 and 7 of A7K5 (auto/remote power adjust relay) to B4 (power adjust motor). Applying operating voltage through terminal 4 of TB9 causes B4 to turn counterclockwise, thus reducing the plate voltage of the modulator and power amplifier tubes. Decrease of the plate voltage causes a corresponding decrease in the power output level. The raise circuit is similar to the lower circuit and will not be discussed in detail. Operating voltage is applied through terminal 6 of TB9 causing B4 to turn clockwise. This increases the plate voltage to the modulator and power amplifier tubes. As the plate voltage increases, a corresponding increase occurs in the power output level. Switch A1S7 is spring-loaded and returns to the off position when released.

4.6.5.3 Automatic Power Adjust

The automatic circuit discussion presumes that the power control sensor and the power control servo amplifier are installed. Setting A1S9 (POWER CONTROL) to AUTOMATIC applies 28

volts through contacts of A1S9, through normally closed contacts 8 and 7 of A7K6 (remote power adjust hold relay) to A7K5 (auto/remote power adjust relay). Energizing A7K5 applies operating voltage from the power control servo amplifier through terminal 4 or 6 of TB9 to B4 (power adjust motor). Motor B4 runs counterclockwise or clockwise, lowering or raising the plate voltage of the modulator and power amplifier tubes. This causes a corresponding change in the power output level. A change in the output level, sensed by the power control sensor, causes the power control servo amplifier to provide operating voltage to B4.

4.6.5.4 Power Control Sensor (Optional)

The power control sensor senses the output power (current) level and applies the signal to the power control servo amplifier. Inductor A8L1 senses the carrier current and A8CR1 rectifies it. The signal is filtered and applied through A6J1 pins 11 and 10 to the power control servo amplifier.

4.6.5.5 Power Control Servo Amplifier (Optional)

The power control servo amplifier consists of two relays, an electronic chopper, and a servo amplifier. Resistor A6R29 in conjunction with zener diode A6CR1 develops a dc voltage reference signal for the power control servo amplifier. The input signal is compared to the reference voltage and the difference signal is applied through the electronic chopper (A6Q1, A6Q2, and associated circuitry) to serve as an input error signal for the servo amplifier (A6Q3 through A6Q7 and associated circuitry). The error signal causes the servo amplifier to run the power adjust motor B4. Motor B4 adjusts the high voltage which in turn adjusts the power output, resolving the error signal to zero or near zero.

Reduced power operation deenergizes A6K1 and energizes A6K2 (low power relay). Resistor A6R28 (low power adjust) allows adjustment of exact automatic power level for the low-power mode. The remainder of the power control servo amplifier is identical to that of the high-power mode. The servo amplifier input is grounded when plate voltage is removed, preventing B4 from running to a limit. Remote operation of the output power control circuit, both manual and automatic, may be selected through additional optional equipment. In remote operation, however, manual adjustment overrides and switches out the automatic circuit.

4.6.6 DC Overload Circuit

Dc overload is sensed in the high voltage circuit. If an overload condition exists, an energizing signal for K3 (dc overload relay) is developed across R14. Energizing K3 removes 28 volts dc from relays K5, K6, and K7; thus it also removes bias, screen, and plate voltages from the respective circuits. To recycle, after an overload has occurred, push HIGH POWER ON or LOW POWER ON to restore respective mode of operation. Refer to paragraphs 4.6.2.3 and 4.6.2.4 for discussion of high-power and low-power operations. If the overload condition persists, refer to sections 2 and 5.

4.7 REMOTE CONTROL, EXTERNAL INTERLOCK, AND METERING CIRCUITS

4.7.1 Remote Control

The 820D-1 can be installed for remote operation at an unattended site. If installed at an unattended site, remote control relay boards A2A1 and A2A2 are used. Relay board A2A1 contains five relays and A2A2 contains four relays; the relays are controlled from a distant studio in the conventional manner. The relays perform the following functions: filament on/off, plate off/fail safe, low power on/off, high power on/off, remote automatic power adjust, and power adjust raise/lower. The relays operate from 115 volts ac, 28 volts dc, or 48 volts dc. Refer to figure 2-4.

4.7.2 External Interlock

Terminal board TB3 provides connection to various closed loops in the control circuits. The closed loops, interlocked by contacts of the control relays, can be used to control the operation of different pieces of equipment that may be used with the 820D-1. Functional operation of the closed loops includes fail/safe, filament off, low power, high power, and automatic power remote.

4.7.3 Metering Circuit

All metering circuits in the 820D-1 are operated at or near ground potentials (figure 4-3). The outputs from the metering circuits are connected to meters on extended control panel A1 and to test jacks on the front of the transmitter. Remote monitoring of the power amplifier plate voltage and plate current is available using built-in meter shunts. Equal level sampling of the modulation full power and cutback power operation, is provided from a monitor-sampling coil.

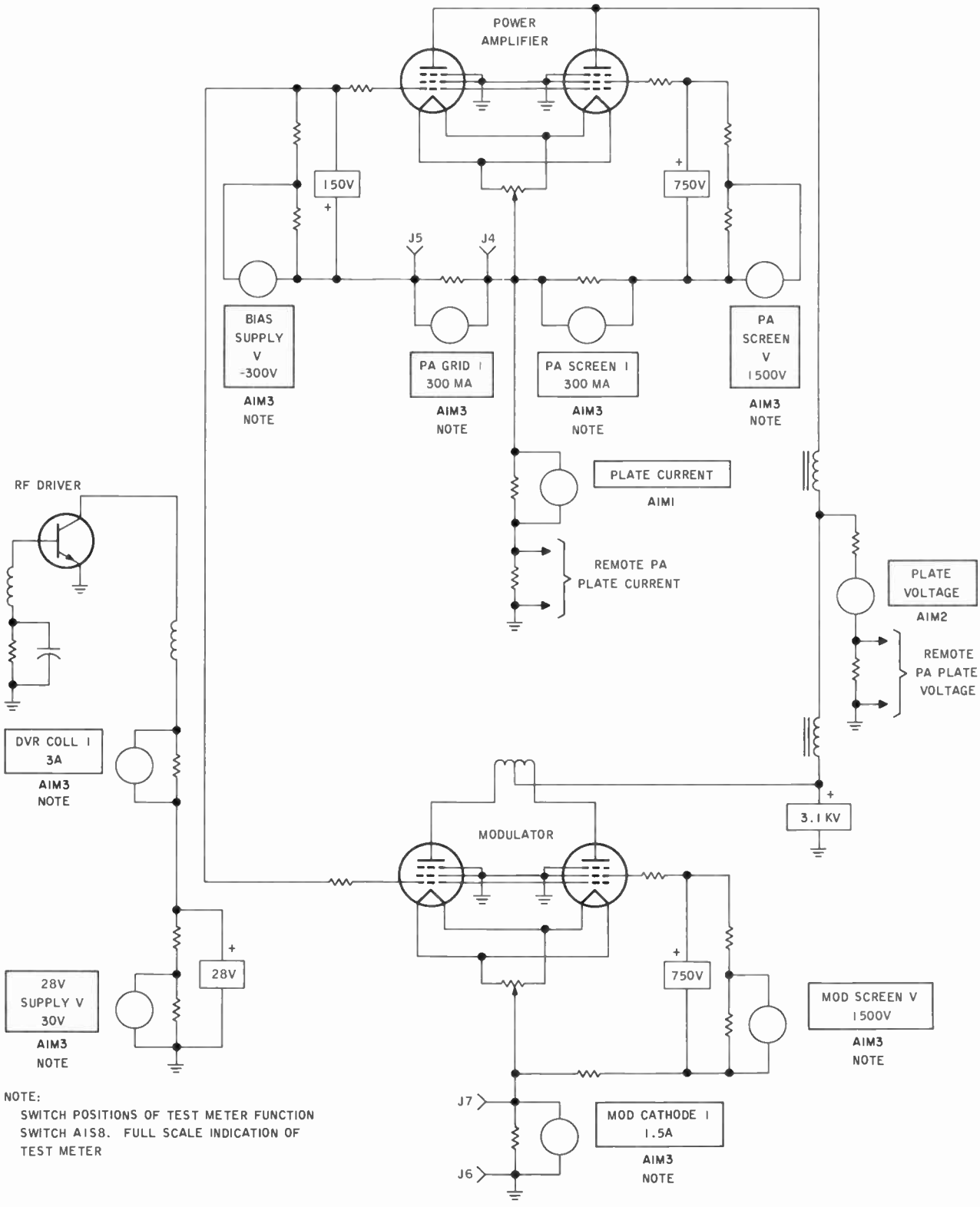


Figure 4-3. Metering Circuits, Simplified Schematic.

section 5
maintenance

5.1 GENERAL

The 820D-1 has been carefully designed, inspected, and adjusted at the factory in order to reduce maintenance to a minimum. However, to ensure peak performance, adhere to a regular schedule of periodic checks and maintenance procedures. Refer to the parts list, section 6, for the location of components in the 820D-1.

Warning

Before working inside the 820D-1, unless otherwise instructed, turn off the primary power. Use the shorting stick to discharge all large capacitors.

5.2 CLEANING

Clean the 820D-1 whenever a perceptible quantity of dust accumulates at any point inside the equipment. A solvent consisting of the following mixture may be used as a cleaning material: methylene chloride, 25 percent; perchloroethylene, 5 percent; and drycleaning solvent, 70 percent by volume.

5.2.1 General Cleaning Procedure

To clean the 820D-1, proceed as follows:

a. Remove dust from chassis, panels, and components with a soft-bristle brush.
b. Remove any foreign matter from flat surfaces and accessible areas with a lintless cloth moistened with solvent. Dry with a clean, dry, lintless cloth.
c. Wash switch contacts and the less accessible areas with solvent lightly applied with a small soft-bristle brush.
d. Clean accumulated dust from the modulator and power amplifier tubes with a dry, oil-free jet of air.

5.2.2 Air Filter

The 820D-1 has a permanent-type air filter. The filter should be cleaned whenever a perceptible quantity of dust and dirt accumulates on the filter element. To remove and clean the air filter, proceed as follows:

a. Open the right front door of the 820D-1.
b. Remove the lower right access panel.
c. Remove the air filter from the filter mounting bracket.
d. Remove the heavy dust accumulated on the filter element with a vacuum cleaner. The dust should be removed from the input side.
e. After the dust is removed, pass a fine stream of water through the filter in a direction opposite to air flow.
f. Wash the filter in a solution of hot water and detergent.
g. Replace dry filter in its bracket and secure.
h. Install the lower right access panel.
i. Close the right front door.

5.3 INSPECTION

Perform periodic visual inspection of the 820D-1 at least once each week. Inspect all metal parts for rust, corrosion, and general deterioration. Check wiring and components for signs of overheating. Check the blower and cabinet fan for normal operation. Check all operating controls for smoothness of operation. Check all connections and tighten any nuts, bolts, or screws that are loose.

5.4 LUBRICATION

5.4.1 Power Amplifier Tuning and Power Adjust Motors B3 and B4

Using light oil, lubricate the washer stacks on the shafts of tuning motor B3 and power adjust motor B4. Lubricate approximately every 6 months, as necessary. Two drops of oil on each shaft should be sufficient. The bearings of motors B3 and B4 are sealed and do not require lubrication.

5.4.2 Cabinet Fan and Main Blower

The bearings of the cabinet fan and the main blower are sealed and do not require lubrication.

5.4.3 Hinges

Using light oil, lubricate the two front door and tube compartment panel hinges. Lubricate as necessary for smooth operation.

5.5 TROUBLESHOOTING

If the 820D-1 fails to start or if a failure occurs during normal operation, check each circuit in the order in which it is made operative. Refer to figure 4-2 for assistance in locating troubles in the control circuits. Use front panel meter readings in table 3-2 and nominal voltage and current readings in table 5-1 as an aid for isolating failures that may occur. Tables 5-2 and 5-3 contain the values and selection of capacitors located in tuned circuits for each of the various broadcast operating frequencies. Table 5-4 contains transformer connections. Table 5-5 contains proper operating voltage levels (if instructions in paragraph 3.7 were followed). Refer to the checks and adjustments in sections 2 and 5 for additional information. Refer to the schematic diagram inside the back cover of this manual as needed when troubleshooting the 820D-1.

5.6 CHECKS AND ADJUSTMENTS

5.6.1 RF Driver Frequency Determinate Components Check

Using figure 5-1 and table 5-2, verify that the proper frequency determinate components are installed in the rf driver (module A11 in the tube compartment.

5.6.2 Output Network Frequency Determinate Components Check

Using table 5-3, figure 1-2, and the schematic diagram (if necessary), verify that the proper frequency determinate components are installed in the output network.

5.6.3 ARC Gaps Adjustment

a. Inspect the arc gaps on transformer T1 for burrs, scratches, or sharp edges. If any exist, remove them with crocus cloth.
b. Check arc gaps for 0.075-inch spacing. Adjust spacing if necessary.

5.6.4 High-Voltage Grounding Switches Adjustment

Adjust the high-voltage grounding switches (S7, S8, and S9) for proper operation. Verify the operation as follows:

a. Connect an ohmmeter between ground and positive side of the high-voltage power supply at CR1 pin 1.
b. Verify that a high resistance (not less than 75K) exists when the tube compartment, lower left, and lower right access panels are closed. Verify that a low resistance (not more than 40 ohms) exists when each of the above mentioned panels is opened with the other two closed.
c. Connect an ohmmeter between ground and positive side of the power amplifier screen power supply at the positive terminal of A14CR1.
d. Verify that a high resistance (not less than 20K) exists when the access panels mentioned in step b. are closed. Verify that a low resistance (not more than 175 ohms) exists when each of the above mentioned panels is opened with the other two closed.
e. Connect an ohmmeter between ground and positive side of the modulator screen power supply at the positive terminal of A14CR2.
f. Verify that a high resistance (not less than 80K) exists when the access panels mentioned in step b. are closed. Verify that a low resistance (not more than 175 ohms) exists when each of the above mentioned panels is opened with the other two closed.

5.6.5 Electrolytic Capacitor Ground Check

a. Verify that grounding switches (S7, S8, and S9) are open.
b. Using an ohmmeter, check for a low resistance (not more than 20 ohms) between ground and the negative terminal of capacitors C30, A14C3, and A14C4.
c. Using an ohmmeter, check for a low resistance (not more than 5 ohms) between ground and the negative terminal of capacitors A12C2, A14C5, and A14C6.
d. Using an ohmmeter, check for a low resistance (not more than 20 ohms) between ground and the positive terminal of capacitor A13C2.

Table 5-1. Nominal Voltage Levels (Unmodulated).

FUNCTION	TEST POINTS	NORMAL INDICATION
Modulator filament voltage	E36 to E37	9.5 volts ac
Modulator cathode current	J7 to J6	0.2 volt ac
Modulator grid voltage	A16-7 to A16-5 or A16-8 to A16-5	-112 volts
Modulator peak af driving voltage	A16-7 to A16-5 or A16-8 to A16-5	77 volts
Power amplifier filament voltage	E34 to E35	9.5 volts ac
Power amplifier grid current	J4 to J5	0.4 volt ac
Power amplifier grid voltage	E27 to ground	-200 volts
Power amplifier screen voltage	C6-1 to E22 or C7-1 to E23	680 volts
Power amplifier peak af screen voltage	C6-1 to E22 or C7-1 to E2	50 volts
Power amplifier peak rf grid voltage	E27 to ground	325 volts
Rf driver collector current	A11R3-1 to A11R3-2	1.25 volts
Rf driver collector voltage	A11T1-1 to E10	24 volts
Rf driver base voltage	A11R8-1 to E8	0.9 volt
RF driver peak rf base voltage	A11R8-1 to E8	4.3 volts
A3Q3 emitter current	A3R27 to ground	3.6 volts
A3Q4 emitter current	A3R28 to ground	3.6 volts

Table 5-2. Frequency Determinate Components of the RF Driver.

FREQUENCY (kHz)	*C3A	*C3B	*C3C	*C3D	*C3E
540-550	X			X	X
560-580	X	X	X	X	
590-600		X	X	X	
610-625	X		X	X	
635-645			X	X	
655-675	X	X		X	
685-710		X		X	
720-735	X			X	
745-780				X	
790-850		X	X		
860-890	X		X		
900-965			X		
975-1100	X	X			
1110-1250		X			
1260-1420	X				
1430-1600					

*X denotes active capacitors.

5.6.6 Power Supply Grounds Check

a. Verify that grounding switches are open.
b. Using an ohmmeter, check for a high resistance (not less than 200 ohms) between ground and the negative terminal of A13CR1 (in the bias power supply).
c. Using an ohmmeter, check for a high resistance (not less than 30 ohms) between ground and A12CR1-2 (in the 28-volt supply).
d. Using an ohmmeter, check for a low resistance (not more than 20 ohms) between ground and negative terminal of A14CR1 (in the power amplifier screen supply).
e. Using an ohmmeter, check for a low resistance (not more than 2 ohms) between ground and negative terminal of A14CR2 (in the modulator screen supply).
f. Using an ohmmeter, check for a low resistance (not more than 20 ohms) between ground and positive terminal of A13CR1 (in the bias power supply).
g. Using an ohmmeter, check for a low resistance (not more than 5 ohms) between ground and A12CR4-2.

Table 5-3. Frequency Determinate Components of the Output Network.

FREQUENCY (kHz)	C14 (pf)	C15 (pf)	C16 (pf)	C17 (pf)	C18 (pf)	C19 (pf)
540-700	240	240	3900	3900	3900	3900
710-920	180	None	3000	3000	3000	3000
930-1150	180	None	2400	2400	2400	2400
1160-1380	None	None	2000	2000	2000	2000
1390-1600	None	None	1600	1600	1600	1600

Table 5-4. Transformer Connections.

TRANSFORMER	LINE VOLTAGE			POWER LEVEL
	208 VOLTS	230 VOLTS	240 VOLTS	
A12T1 28-volt	A12TB1-1	A12TB1-1	A12TB1-1	
	A12TB1-2	A12TB1-3	A12TB1-4	
A13T1 bias	A13TB1-7	A13TB1-7	A13TB1-7	
	A13TB1-6	A13TB1-5	A13TB1-5	
A14T1 screen	A14TB1-3	A14TB1-3	A14TB1-3	
	A14TB1-4	A14TB1-5	A14TB1-6	
A15T2 mod filament	A15TB2-1	A15TB2-1	A15TB2-1	
	A15TB2-5	A15TB2-6	A15TB2-7	
A15T1 pa filament	A15TB2-1	A15TB2-1	A15TB2-1	
	A15TB2-2	A15TB2-3	A15TB2-4	
T5 high-voltage	T5-3	T5-2	T5-1	
	T5-5	T5-6	T5-7	550 watts
	T5-3	T5-2	T5-1	
	T5-8	T5-9	T5-10	275 watts
	T5-3	T5-2	T5-1	
	T5-4	T5-4	T4-4	1100 watts

Table 5-5. Normal Operating Voltages.

FUNCTION	REDUCED POWER		FULL POWER
	550 w	275 w	1100 w
Rf driver collector current			
Power amplifier grid current			
Power amplifier screen current			
Power amplifier screen voltage			
Modulator screen voltage			
Modulator cathode current (unmodulated)			
Modulator cathode current (modulated 100 percent)			

Table 5-5. Normal Operating Voltages (Cont).

FUNCTION	REDUCED POWER		FULL POWER
	550 w	275 w	1100 w
Bias power supply voltage Dc power supply voltage (28 volts dc) Power amplifier plate current Power amplifier plate voltage Rf line current (unmodulated) Rf line current (modulated 100 percent)			

FUNCTION	NORMAL VOLTAGE
Modulator filament voltage Modulator cathode current Modulator grid voltage Modulator peak af driving voltage Power amplifier filament voltage Power amplifier grid voltage Power amplifier grid current Power amplifier screen voltage Power amplifier peak af screen voltage Power amplifier peak rf grid voltage Rf driver collector current Rf driver collector voltage Rf driver base voltage Rf driver peak rf base voltage A3Q3 emitter current A3Q4 emitter current	

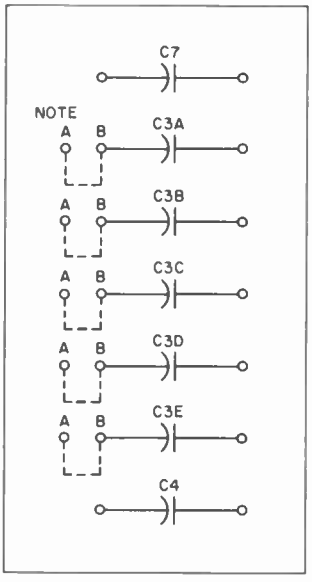


Figure 5-1. RF Driver Components Board, Module A11.

h. Using an ohmmeter, check for 15 ±2 ohms between ground and the negative terminal of CR2 (in the high voltage power supply).

5.6.7 Primary Power Line (AC) Check

a. Verify that no power is applied at TB5-1 and TB5-3.
b. Remove loads from TB8-1 and TB9-1.
c. Close circuit breakers CB1 (LOW VOLTAGE) and CB2 (HIGH VOLTAGE).
d. Using an external dc power supply, operate relay K1.
e. Using an ohmmeter, check that not less than 5-ohm resistance exists between ground and each side of the ac line (TB5-1 and TB5-2).
f. Operate relays K2, K2 and K5, and K2 and K6.
g. Using an ohmmeter, check for a high resistance (not less than 100K) between ground and each side of the ac line for each condition in step f.
h. Reconnect the loads to TB8-1 and TB9-1.

5.6.8 Filament Grounds Check

a. Check power amplifier and modulator filaments for correct wiring. Refer to the schematic diagram located in the envelope inside the back cover of this manual.
b. Using an ohmmeter, check for low resistance (not more than 12 ohms) between power amplifier filament at tube socket and ground.
c. Using an ohmmeter, check for low resistance (not more than 2 ohms) between modulator filament at tube socket and ground.

5.6.9 Test Meter Accuracy Check

Caution

Open circuit breakers CB1 and CB2 and momentarily ground connection points before connecting the external meter in the following procedure.

a. Connect calibrated volt-ohm-milliammeter (vom) to A14E3 and A14E1.
b. Close circuit breakers CB1 and CB2.
c. Push LOW POWER ON pushbutton and observe that the vom indicates approximately 810 volts.
d. Set TEST METER function switch S8 to MOD SCREEN V position. Observe that not more than 5 percent difference exists between TEST METER indication and reading in step c.
e. Push HIGH POWER ON pushbutton and observe that the readings in steps c. and d. do not change.
f. Connect calibrated vom to A14E5 and A14E4.
g. Close circuit breakers CB1 and CB2.
h. Push LOW POWER ON pushbutton and observe that the vom indicates approximately 680 volts.
i. Set TEST METER function switch S8 to PA SCREEN V position.
j. Observe that not more than 5 percent difference exists between TEST METER indication and reading in step h.
k. Push HIGH POWER ON pushbutton and observe that the readings in steps h. and j. do not change.
l. Check that F1 (a 1-ampere fuse on the fuse and breaker panel, figure 1-2) is properly installed and does not need to be replaced.
m. Connect calibrated vom to A13TB-2 and A13TB1-4.

TABLE I

FREQUENCY	C14	C15	C16	C17	C18	C19
540-700	430pF 10KV	240pF 10KV	3900pF 6KV	3900pF 6KV	3900pF 6KV	3900pF 6KV
710-920	430pF 10KV	NONE	3000pF 6KV	3000pF 6KV	3000pF 6KV	3000pF 6KV
930-1150	240pF 10KV	NONE	2400pF 6KV	2400pF 6KV	2400pF 6KV	2400pF 6KV
1160-1380	180pF 10KV	NONE	2000pF 6KV	2000pF 6KV	2000pF 6KV	2000pF 6KV
1390-1600	NONE	NONE	1600pF 6KV	1600pF 6KV	1600pF 6KV	1600pF 6KV

TABLE II
X DENOTES ACTIVE CAPACITORS

FREQUENCY	C3 A	C3 B	C3 C	C3 D	C3 E
540-550	X			X	X
560-580	X	X	X	X	
590-600		X	X	X	
610-625	X		X	X	
635-645			X	X	
655-675	X	X		X	
685-710		X		X	
720-735	X			X	
745-780				X	
790-850		X	X		
860-890	X		X		
900-965			X		
975-1100	X	X			
1110-1250		X			
1260-1420	X				
1430-1600					

TABLE III

POWER LEVEL	LINE VOLTAGE 208	230	240
500W	T5-3 T5-5	T5-2 T5-6	T5-1 T5-7
250W	T5-3 T5-8	T5-2 T5-9	T5-1 T5-10
1KW	T5-3 T5-4	T5-2 T5-4	T5-1 T5-4

LTR	DESCRIPTION	DATE	APPROVED
F	MISC ERRORS & CORRECTIONS		
G	MISC ERRORS & CORRECTIONS		
H	MISC ERRORS & CORRECTIONS		
I	MISC ERRORS & CORRECTIONS		
J	MISC ERRORS & CORRECTIONS		
K	MISC ERRORS & CORRECTIONS		
L	MISC ERRORS & CORRECTIONS		
M	ADD PLT. CONT. RELAYS	12-3-68	
N	MISC CHANGES	8-31-70	

-001

LIST OF MATERIAL OR PARTS LIST

COLLINS RADIO COMPANY
CEDAR RAPIDS, IOWA · NEWPORT BEACH, CALIF. · DALLAS, TEXAS · TORONTO, ONTARIO

SCHEMATIC
TYPE 820E-1
1 KW AM BROADCAST TRANSMITTER

SIZE J · CODE IDENT NO. 13499 · DWG NO. 771-9021

APPLICATION: -001 582-3591-000 820E-1; -001 582-3594-000 820E-1

n. Close circuit breakers CB1 and CB2. Push FILAMENT ON pushbutton. Observe that the vom indicates approximately -155 volts.
o. Set TEST METER function switch to BIAS SUPPLY V position. Observe that not more than 5 percent difference exists between TEST METER indication and reading in step n.
p. Push FILAMENT OFF pushbutton and remove the vom.

5.6.10 Overload Circuit Adjustment

Warning

Open the primary disconnect switch. Open circuit breakers CB1 and CB2.

a. Set R14 for maximum resistance.
b. Connect the external dc power supply to R14-1 and ground. Apply -14.5 volts dc.
c. Adjust R14 until relay K3 just energizes.
d. Remove the external power supply and close the primary disconnect switch.
e. Close circuit breakers CB1 and CB2.

5.6.11 RF Tuning

a. Set A16R11 (MOD 1 DRIVE, figure 1-2) and A16R10 (MOD 2 DRIVE) fully clockwise.
b. Set A16R9 (MOD 1 BIAS) and A16R8 (MOD 2 BIAS) fully counterclockwise.
c. Push LOW POWER ON pushbutton and hold until PLATE OFF indicator goes out.
d. Note rf output current. Note correct plate voltage. (Refer to table 3-2).
e. Observe that plate current is not excessive.
f. Adjust A11C3 (PA GRID TUNING) for maximum grid current. Observe that A11C3 is tuned at some point within the adjustment range and not at either extreme position.
g. Adjust A11R2 for approximately 2.5 to 2.7 ampere collector current.
h. Now adjust A11R2 until grid current just starts to decrease. At this point, observe that collector current is 2.3 to 2.5 amperes.

5.6.12 Modulator Static Adjustment

a. Push HIGH POWER ON pushbutton.
b. Using MOD 1 BIAS and MOD 2 BIAS (figure 1-2), adjust both modulator tubes to cutoff or near cutoff. Note static current (Io) at this point.
c. Adjust MOD 1 BIAS and observe indication of 100 ma ±Io/2 on TEST METER for MOD CATHODE I position.
d. Adjust MOD 2 BIAS for 100 ma ±Io/2 indication.

5.6.13 Modulation Monitor Adjustment

Caution

Voltage at J3 must not exceed 20 volts p-p under carrier conditions.

a. Push FILAMENT OFF pushbutton.
b. Connect distortion analyzer to J3 (modulation monitor output). Remove output network cover.
c. Push HIGH POWER ON pushbutton. Adjust output power for desired level. Peak the distortion analyzer.
d. Adjust pin 3 on inductor L15 for a 12-volt p-p indication at J3.
e. Push LOW POWER ON pushbutton. Peak the distortion analyzer.
f. Adjust pin 4 on inductor L15 for a 12-volt p-p indication at J3.
g. Push FILAMENT OFF pushbutton and disconnect the distortion analyzer.

5.6.14 Audio Frequency Distortion Adjustment

a. Disconnect the modulation monitor from J3. Connect the distortion analyzer and an oscilloscope (if desired) to J3. If the oscilloscope is used, employ the X10 isolation probe.
b. Push HIGH POWER ON pushbutton and determine audio distortion over the range of 50 Hz to 10 kHz at 95 percent modulation.
c. Adjust MOD 1 or MOD 2 DRIVE to obtain minimum distortion. Leave the other (MOD 1 or MOD 2 DRIVE) potentiometer set fully clockwise.
d. Disconnect the distortion analyzer and oscilloscope (if used). Reconnect the modulation monitor to J3.

5.6.15 Output Network Tuning

The output network is adjusted during factory test for the customer frequency. The output network should require no additional adjustment. However, if adjustment is required, perform the following procedure. In order to properly tune the output network, the network must be bridged

(use the rf impedance bridge, the rf signal generator, and the rf detector) at various points in the circuit. Fine adjustments are made to give the correct impedance values after the preliminary adjustments are completed.

Warning

Verify that CB2 is open and momentarily ground test points on figure 5-2.

a. Make preliminary adjustments indicated in figures 5-3 through 5-8.
b. Disconnect the strap from capacitor C13 to inductor L6 and bridge (the rf signal generator set to transmitter frequency) from TP1 (figure 5-2) to ground.
c. Adjust C13 for 321-ohm reactance. Reconnect the strap from C13 to L6.
d. Connect shorting clip lead from TP2 to ground. Bridge from TP3 to ground.
e. Adjust strap 5 for a 0-ohm reactance bridge reading.
f. Adjust strap 6 for a resistance value R_{33} (figure 5-9).
g. Move shorting clip lead from TP2 to TP1 and ground. Bridge from TP2 to ground.
h. Adjust strap 3 for a 0-ohm reactance bridge reading.
i. Adjust strap 4 for a resistance value R_{22} (figure 5-10).

Note

The output network grounding switches must be open before the following measurements are made.

j. Move the shorting clip lead from TP1 to TP3 and ground.
k. Install the 3350-ohm resistor between TP4 and ground (figure 5-2).
l. The bridge is still connected from TP2 to ground.
m. Adjust strap 1 for a 0-ohm reactance bridge reading.
n. Adjust strap 2 for a resistance value $R22_C$ (figure 5-10).
o. Remove the 3350-ohm resistor, the shorting clip lead, and the bridge from the transmitter.

5.7 REPLACEMENT OF PARTS

5.7.1 Meters Located on Extended Control Panel A1

a. Remove screws that secure the extended control panel to the rack.
b. Carefully remove the extended control panel from the rack and set it on an adjacent table or bench.

Note

The length of the cable connected to the back of the panel is sufficient to allow the panel to be moved a short distance from the rack.

c. Tag and remove the two wires from the back of the meter.
d. Remove the screw from each of the two triangular brackets that secure the meter to the panel. Remove the two brackets.
e. Carefully remove the meter from the panel.
f. Place the new meter in position and secure with the two triangular brackets.
g. Connect the two wires to the back of the meter.
h. Place the extended control panel in position on the rack and secure.

5.7.2 Lamps Located on Extended Control Panel A1

Lamps are located inside each of the pushbutton switches on the front of extended control panel A1. To replace a lamp in any of the pushbuttons, use the following steps:

a. Pull on the pushbutton until a click is heard.
b. Rotate the pushbutton counterclockwise 90°.
c. Pull on the pushbutton until it clears the panel.
d. Remove the defective lamp from its holder and replace with a new lamp (type 327).
e. Replace the pushbutton in its holder and rotate clockwise 90°.
f. Press the pushbutton in until it is seated properly.

5.7.3 Replacement of Circuit Breakers

a. Open the right front door on the 820D-1.

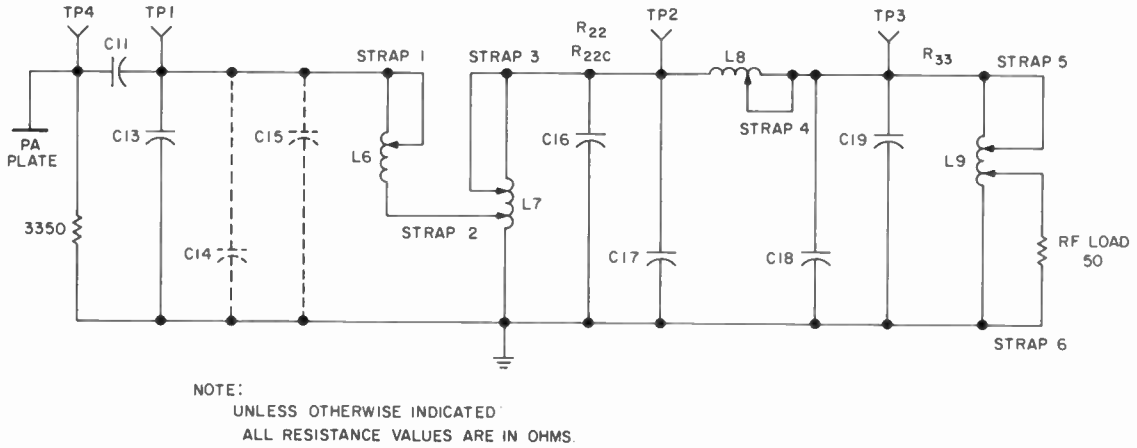


Figure 5-2. Output Network, Simplified Schematic.

b. Remove the circuit breaker panel.
c. Tag and disconnect the wires on the back of the circuit breaker.
d. Remove the four screws that secure the circuit breaker to the panel.
e. Slide the circuit breaker out the back of the panel.
f. Place the new circuit breaker in the proper position on the panel and secure with the four screws.
g. Connect the wires to the back of the circuit breaker. Ensure that the wires are connected to the correct terminals.
h. Install the circuit breaker panel and close the right front door.

5.8 ORDERING REPLACEMENT PARTS

For information on ordering replacement parts, refer to the inside front cover.

Refer to table 5-6 for crystal part numbers.

Table 5-6. Crystal Part Numbers.

OPERATING FREQUENCY (kHz)	COLLINS PART NUMBER	OPERATING FREQUENCY (kHz)	COLLINS PART NUMBER	OPERATING FREQUENCY (kHz)	COLLINS PART NUMBER
540	289-7021-010	680	289-7021-290	820	289-7021-550
550	289-7021-030	690	289-7021-310	830	289-7021-560
560	289-7021-050	700	289-7021-330	840	289-7021-570
570	289-7021-070	710	289-7021-350	850	289-7021-580
580	289-7021-090	720	289-7021-370	860	289-7021-590
590	289-7021-110	730	289-7021-390	870	289-7021-600
600	289-7021-130	740	289-7021-410	880	289-7021-610
610	289-7021-150	750	289-7021-430	890	289-7021-620
620	289-7021-170	760	289-7021-450	900	289-7021-630
630	289-7021-190	770	289-7021-470	910	289-7021-640
640	289-7021-210	780	289-7021-490	920	289-7021-650
650	289-7021-230	790	289-7021-510	920	289-7021-660
660	289-7021-250	800	289-7021-530	940	289-7201-670
670	289-7021-270	810	289-7021-540	950	289-7021-680

Table 5-6. Crystal Part Numbers (Cont).

OPERATING FREQUENCY (kHz)	COLLINS PART NUMBER	OPERATING FREQUENCY (kHz)	COLLINS PART NUMBER	OPERATING FREQUENCY (kHz)	COLLINS PART NUMBER
960	289-7021-690	1180	289-7021-110	1400	289-7021-330
970	289-7021-700	1190	289-7021-120	1410	289-7021-340
980	289-7021-710	1200	289-7021-130	1420	289-7021-350
990	289-7021-720	1210	289-7021-140	1430	289-7021-360
1000	289-7021-730	1220	289-7021-150	1440	289-7021-370
1010	289-7021-740	1230	289-7021-160	1450	289-7021-380
1020	289-7021-750	1240	289-7021-170	1460	289-7021-390
1030	289-7021-760	1250	289-7021-180	1470	289-7021-400
1040	289-7021-770	1260	289-7021-190	1480	289-7021-410
1050	289-7021-780	1270	289-7021-200	1490	289-7021-420
1060	289-7021-790	1280	289-7021-210	1500	289-7021-430
1070	289-7021-800	1290	289-7021-220	1510	289-7021-440
1080	289-7021-810	1300	289-7021-230	1520	289-7021-450
1090	289-7021-020	1310	289-7021-240	1530	289-7021-460
1100	289-7021-030	1320	289-7021-250	1540	289-7021-470
1110	289-7021-040	1330	289-7021-260	1550	289-7021-480
1120	289-7021-050	1340	289-7021-270	1560	289-7021-490
1130	289-7021-060	1350	289-7021-280	1570	289-7021-500
1140	289-7021-070	1360	289-7021-290	1580	289-7021-510
1150	289-7021-080	1370	289-7021-300	1590	289-7021-520
1160	289-7021-090	1380	289-7021-310	1600	289-7021-530
1170	289-7021-100	1390	289-7021-320		

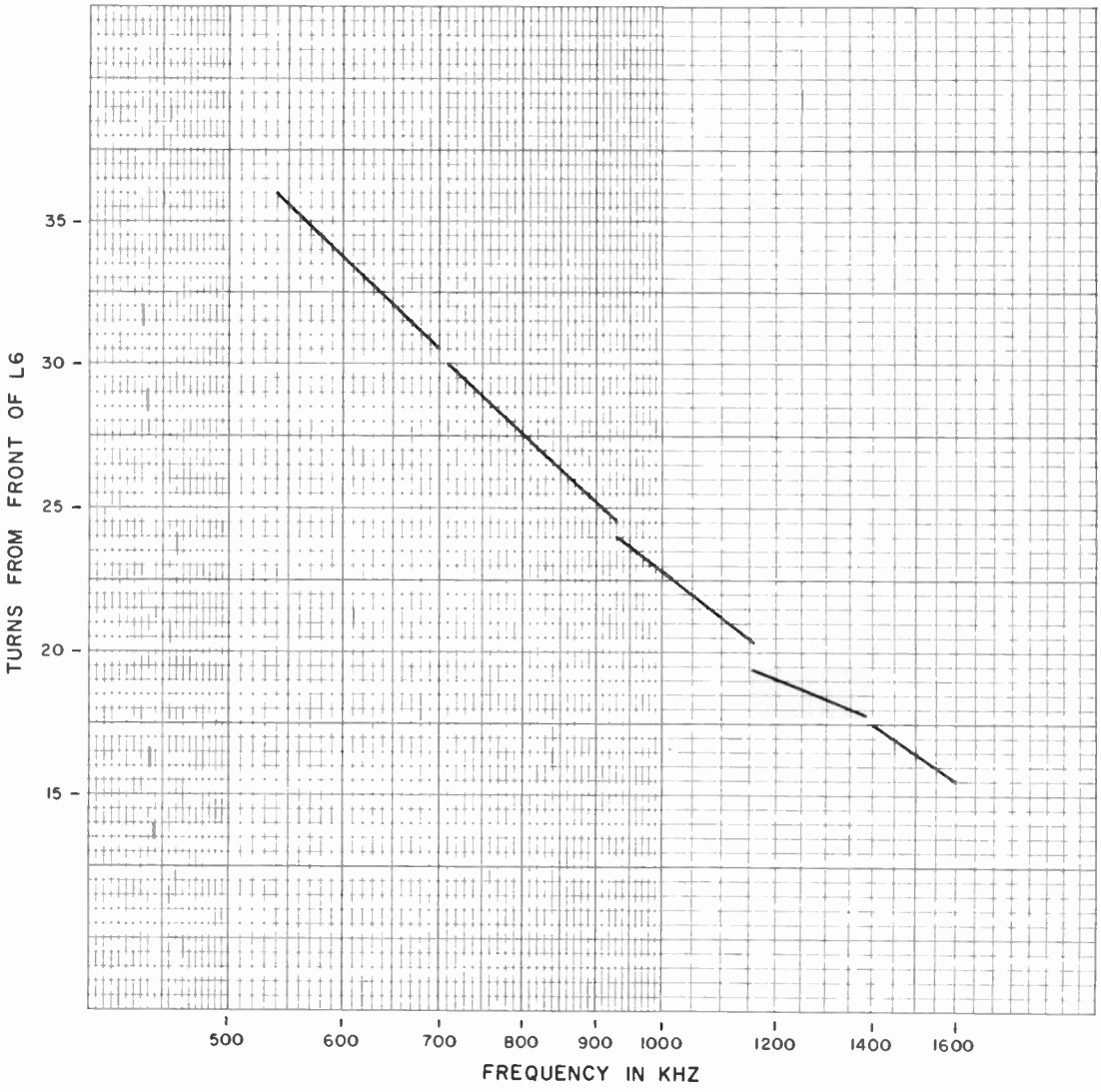


Figure 5-3. Approximate Settings for Strap 1.

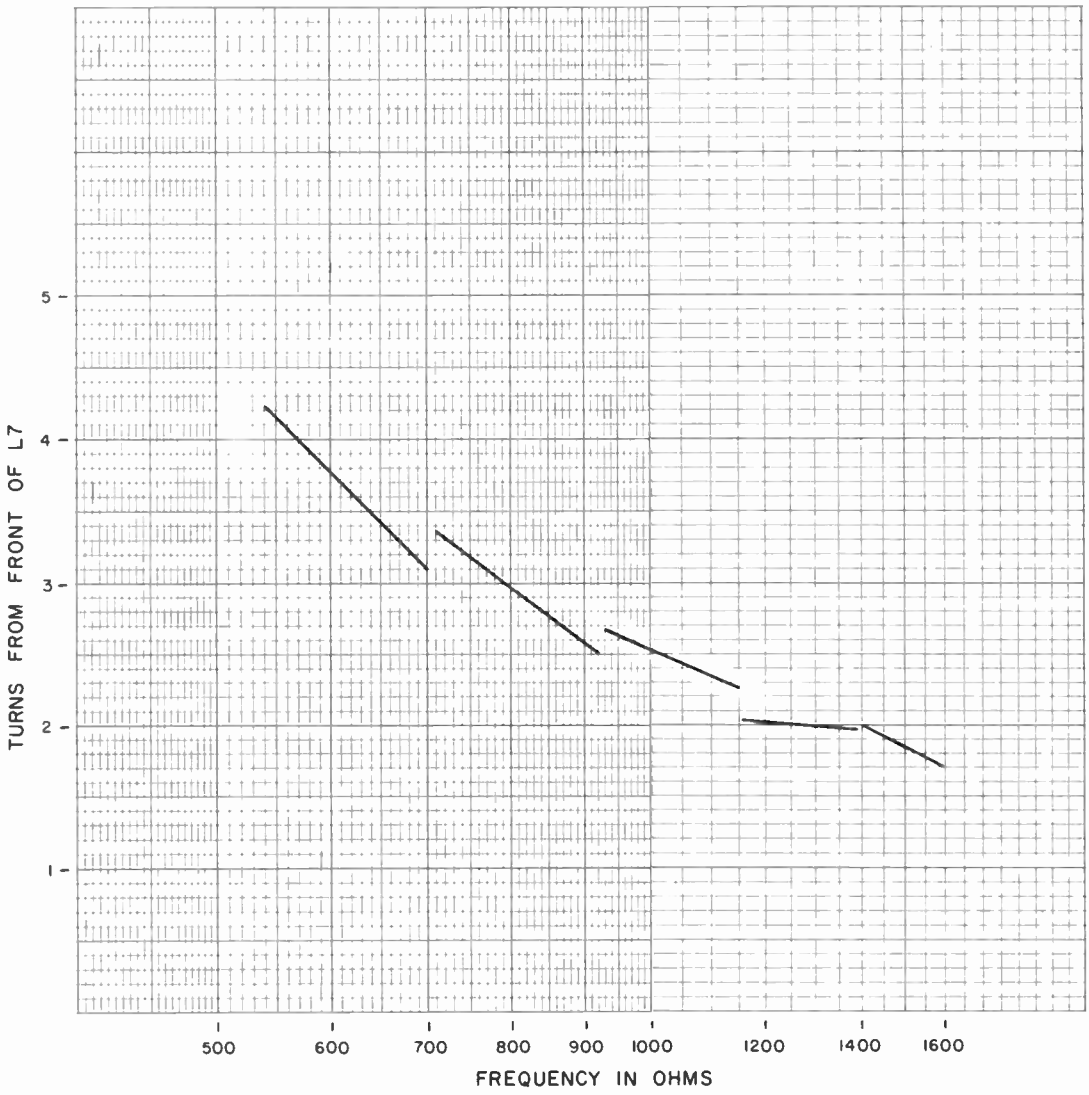


Figure 5-4. Approximate Settings for Strap 2.

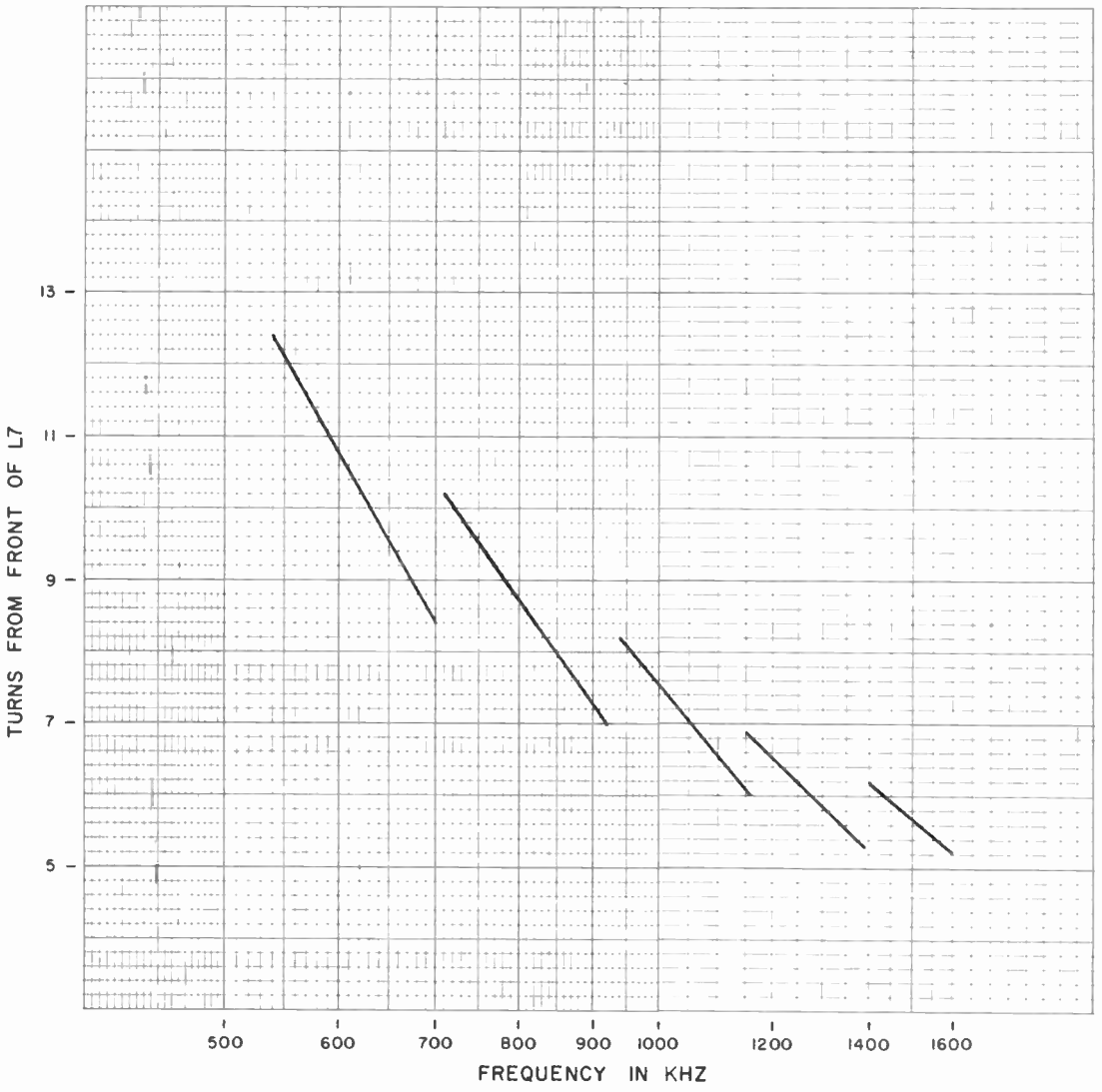


Figure 5-5. Approximate Settings for Strap 3.

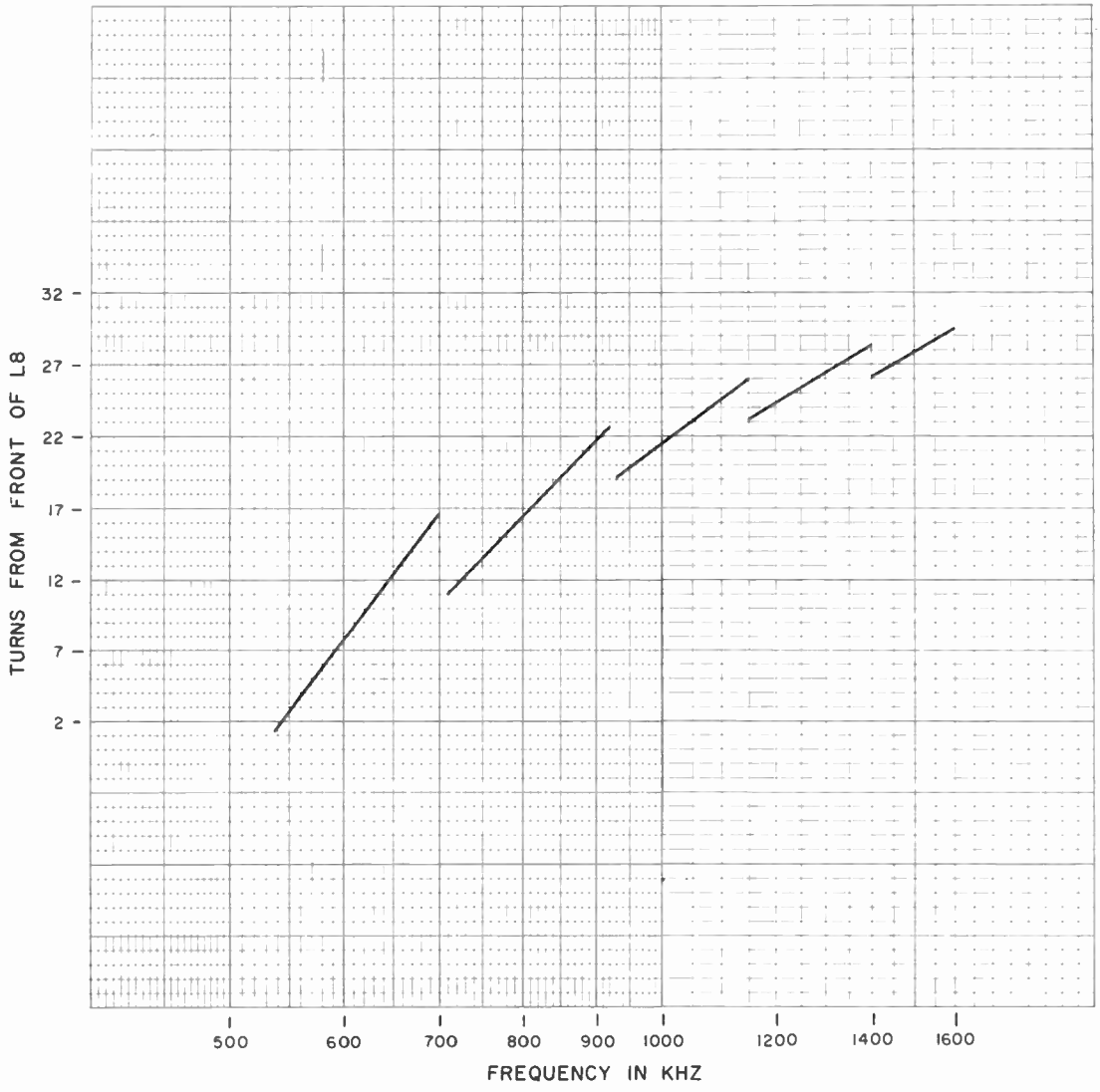


Figure 5-6. Approximate Settings for Strap 4.

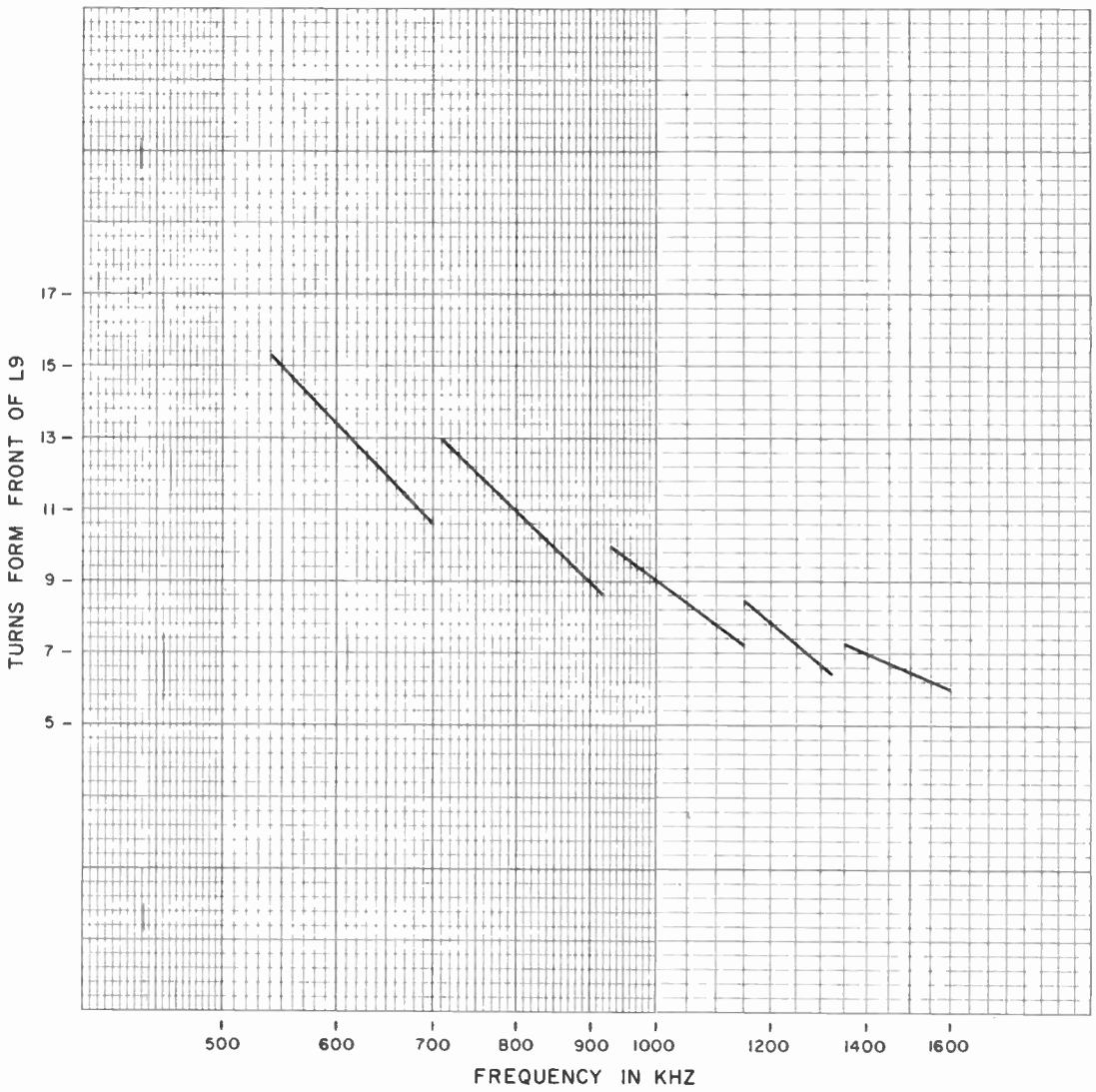


Figure 5-7. Approximate Settings for Strap 5.

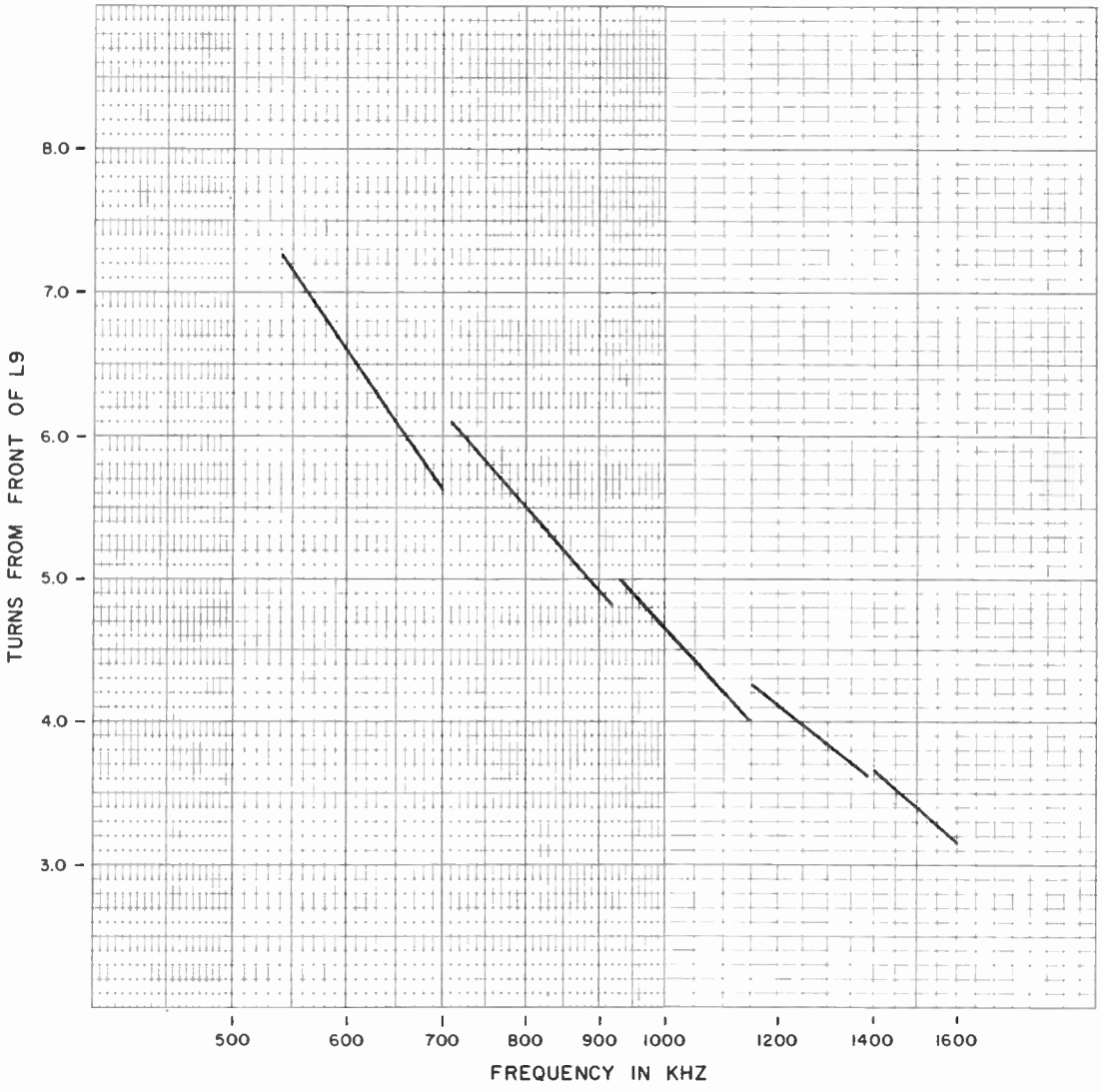


Figure 5-8. Approximate Settings for Strap 6.

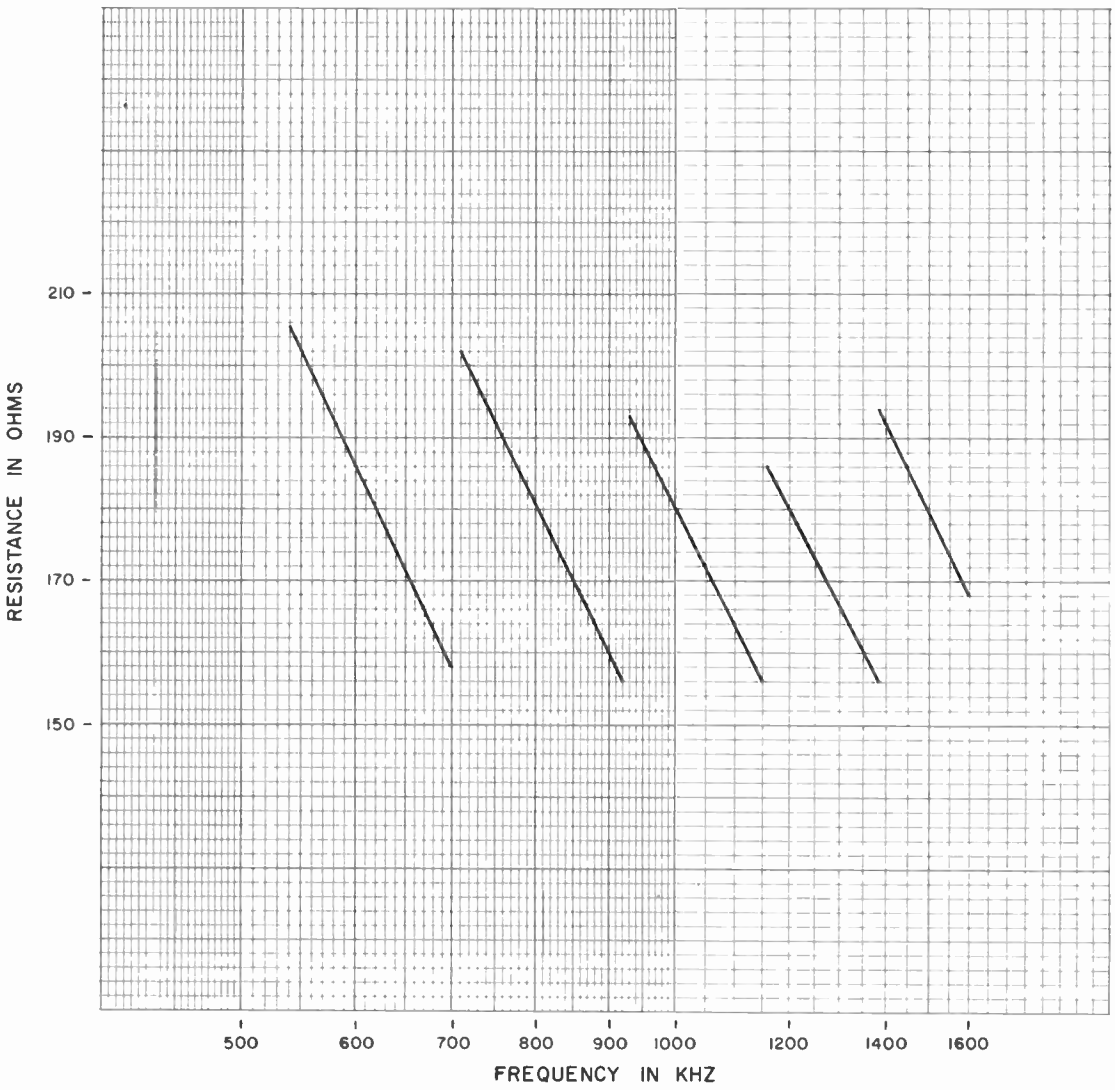


Figure 5-9. Resistance R_{33} Values.

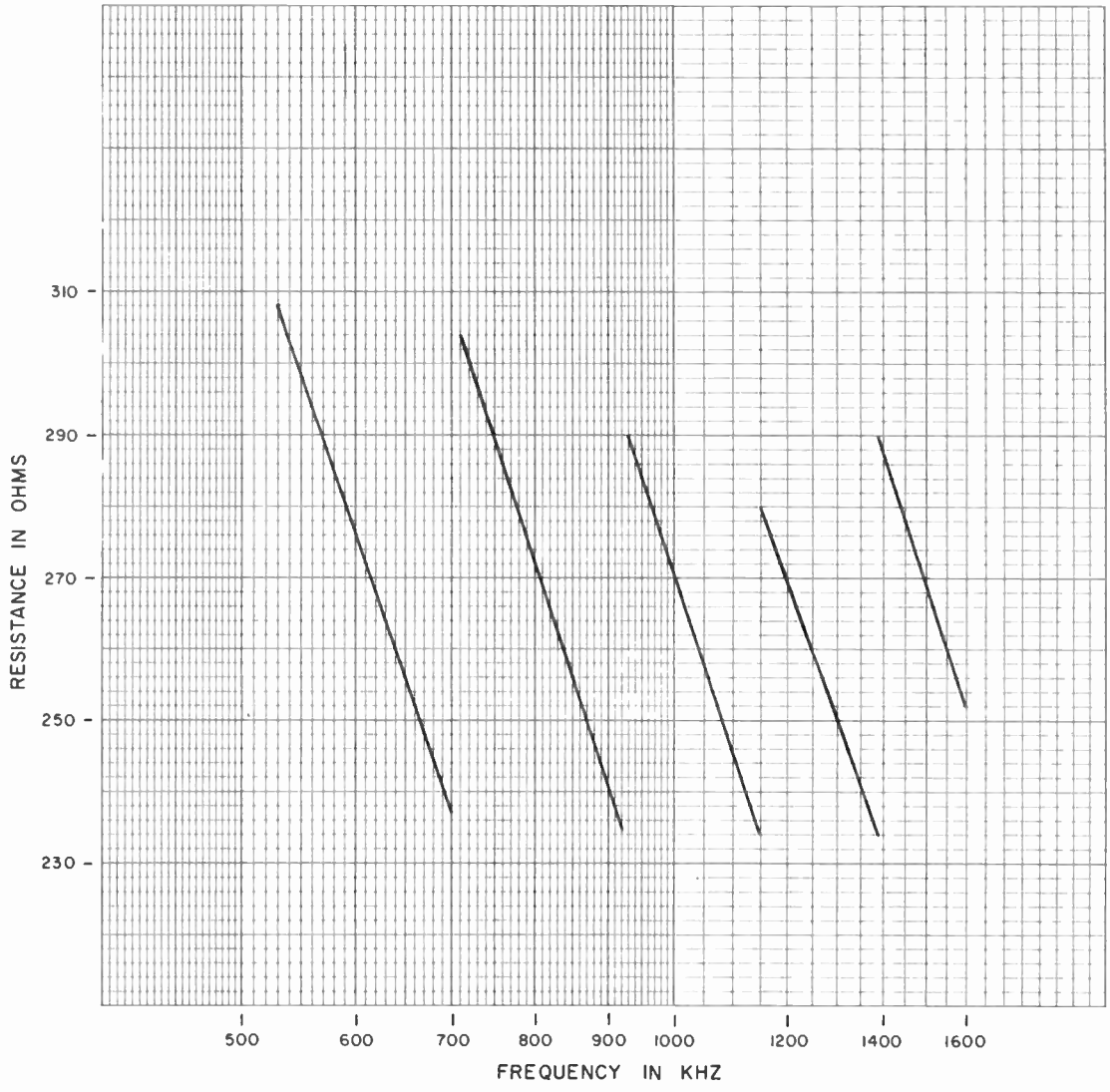


Figure 5-10. Resistance $R_{22} = R_{22C}$ Values.

section 6
parts list

6.1 GENERAL

This section contains a list of all replaceable electrical, electronic, and critical mechanical parts for the 820D-1 AM Broadcast Transmitter (522-3391-xxx).

The manufacturers' codes appearing in the MFR CODE column of the parts list are listed in numerical order at the end of the parts list. The code list provides the manufacturer's name and address as shown in the Federal Supply Code for Manufacturers' Handbook H4-1. Manufacturers not listed in Handbook H4-1 are assigned a five-letter code and will appear first in the code list.

6.2 LIST OF EQUIPMENT

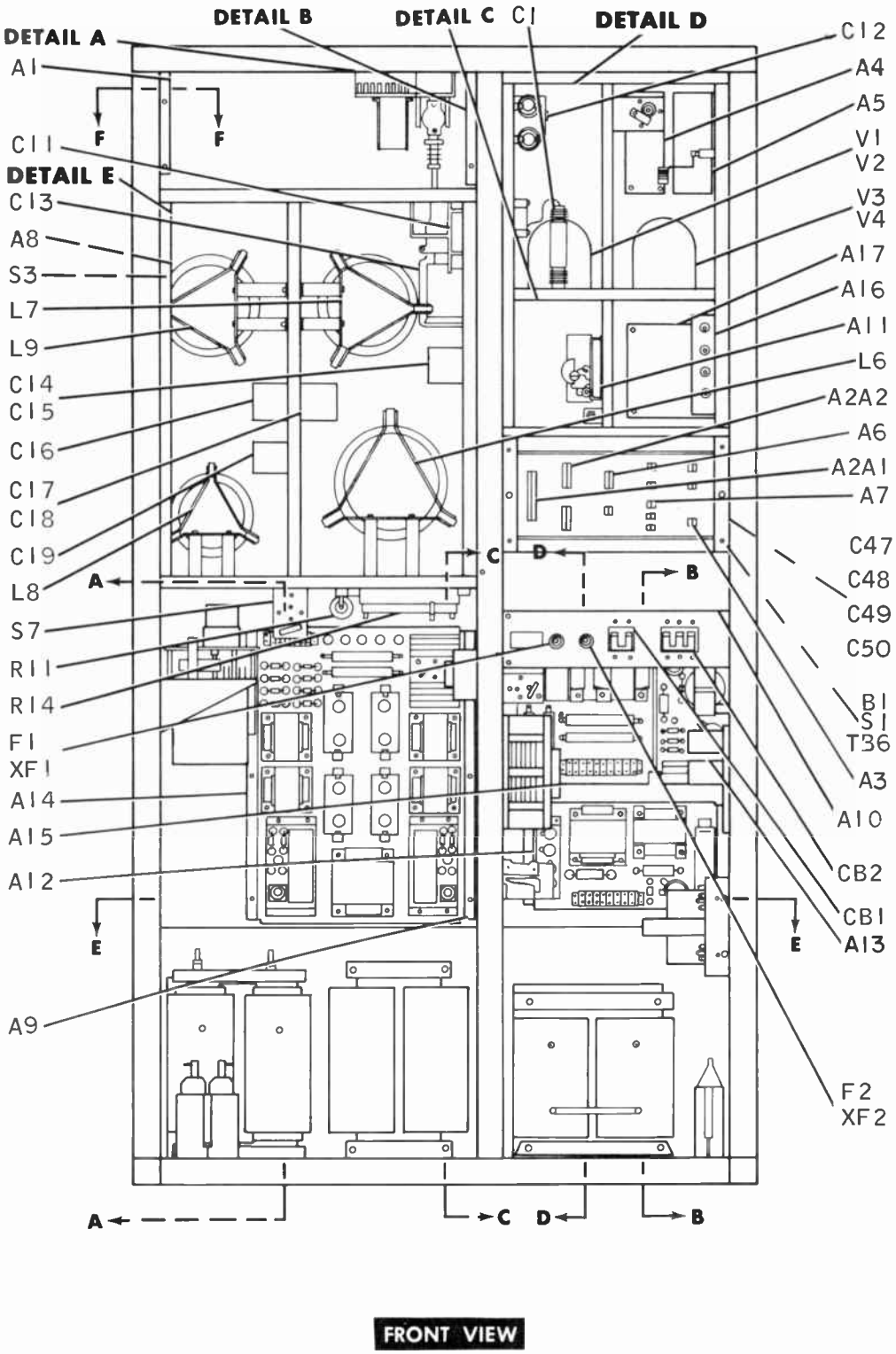


Figure 6-1. 820D-1 AM Broadcast Transmitter (Sheet 1 of 12).

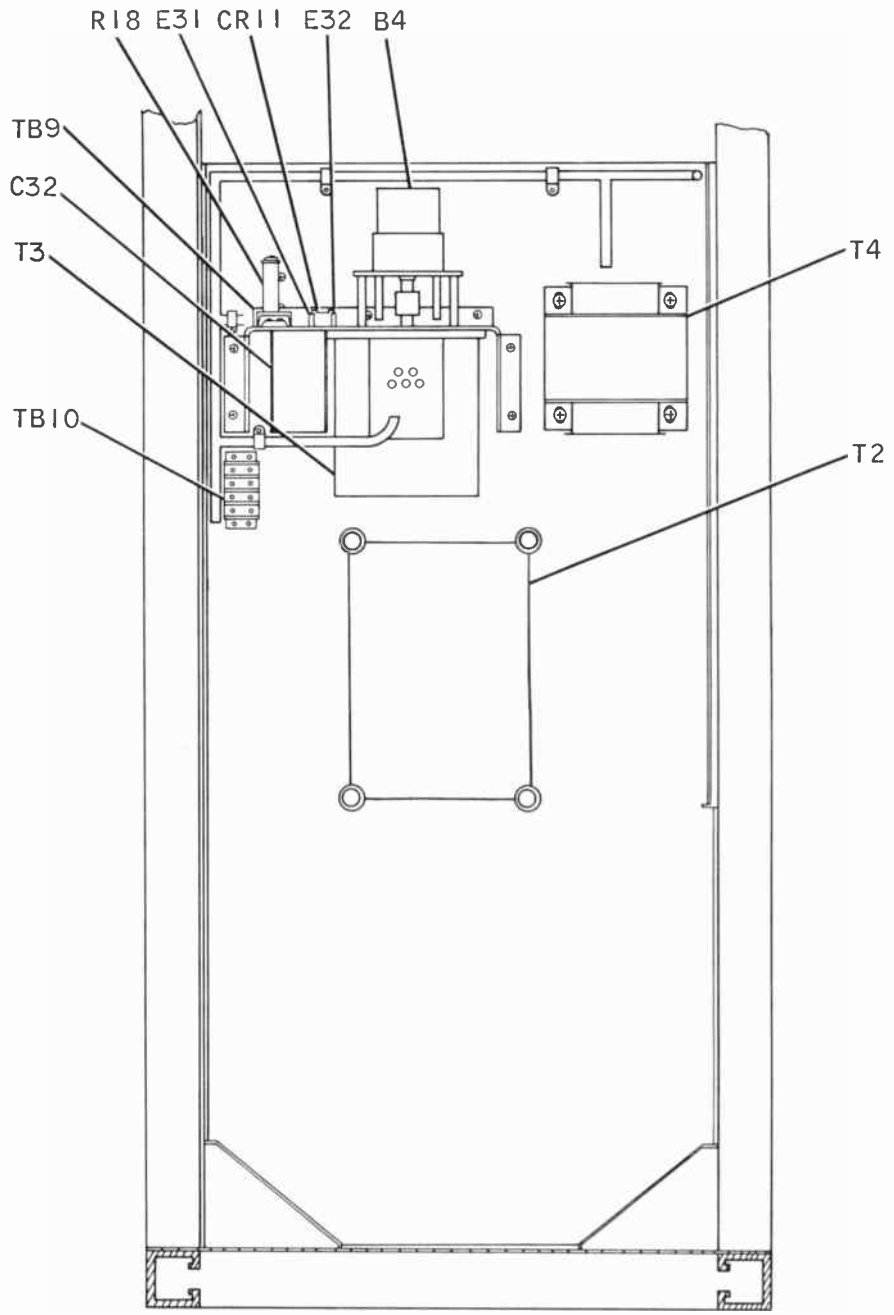


Figure 6-1. 820D-1 AM Broadcast Transmitter (Sheet 2 of 12).

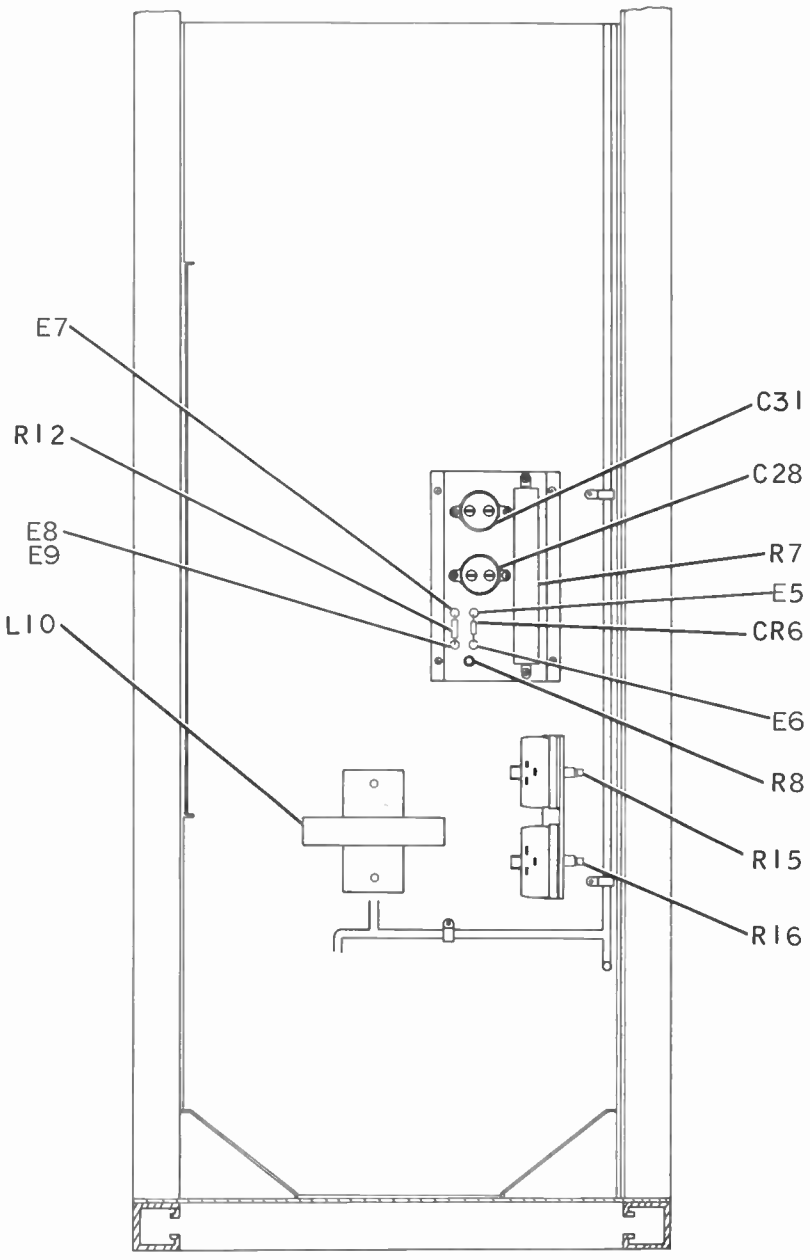


Figure 6-1. 820D-1 AM Broadcast Transmitter (Sheet 3 of 12).

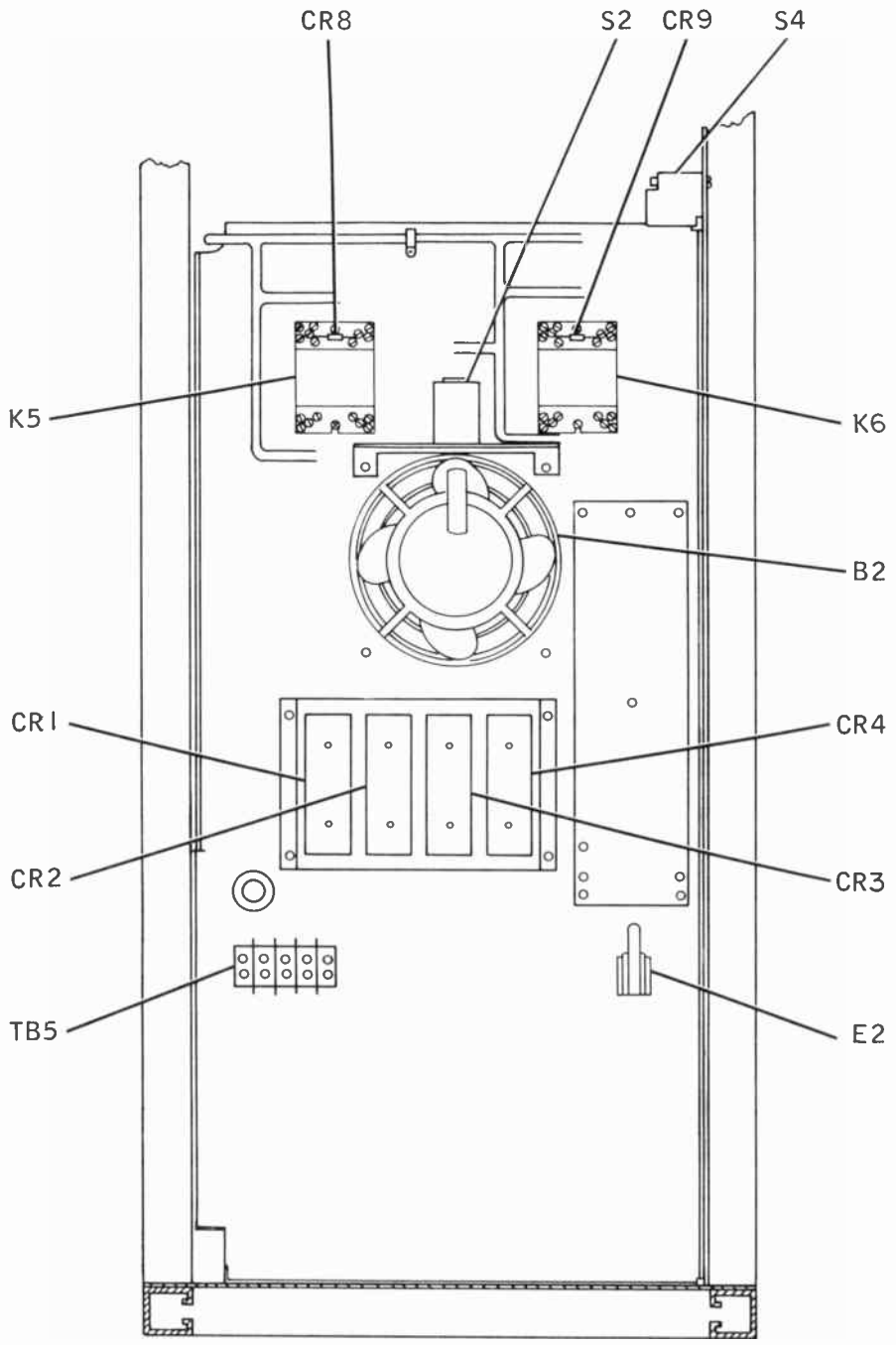
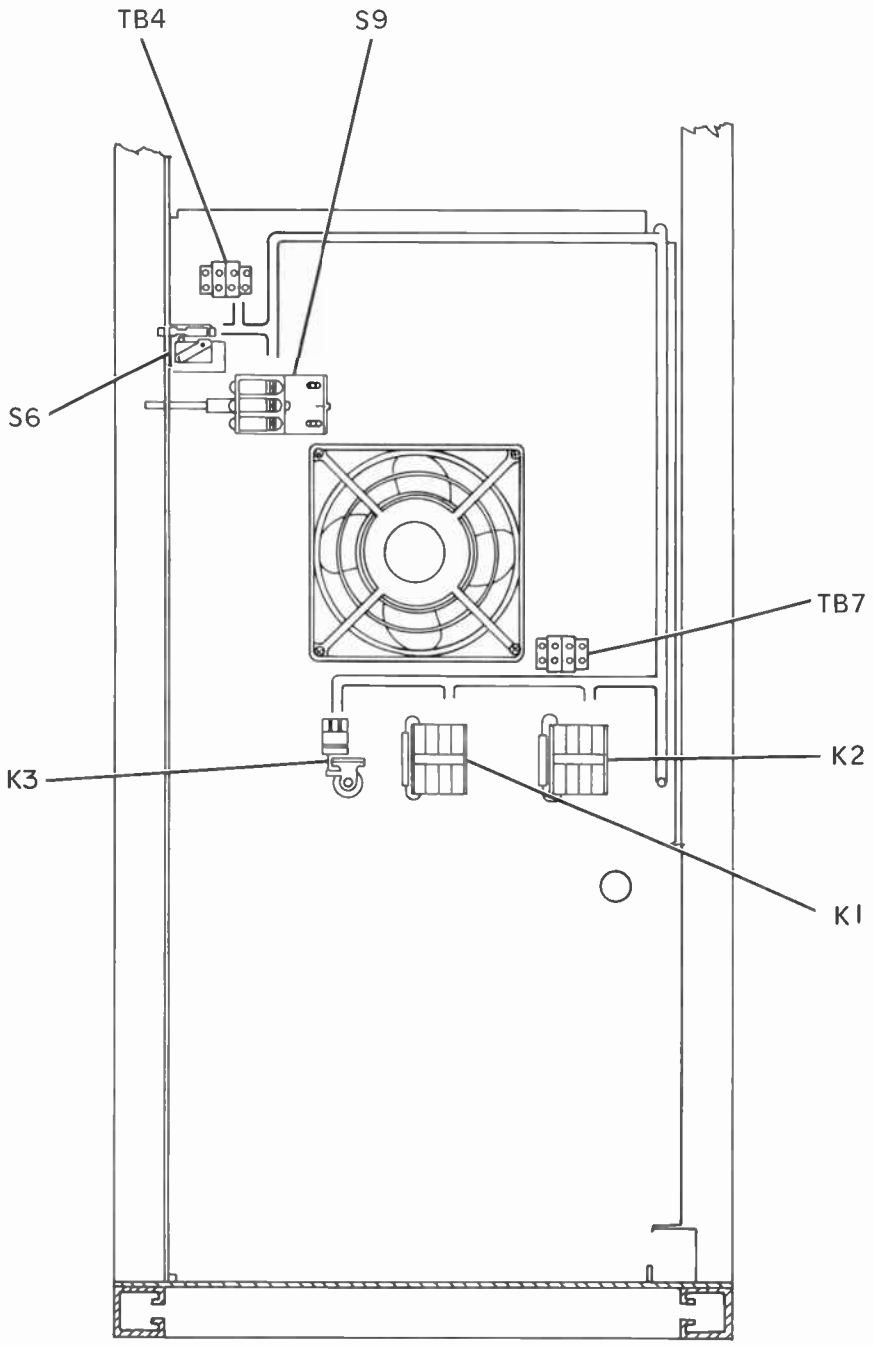
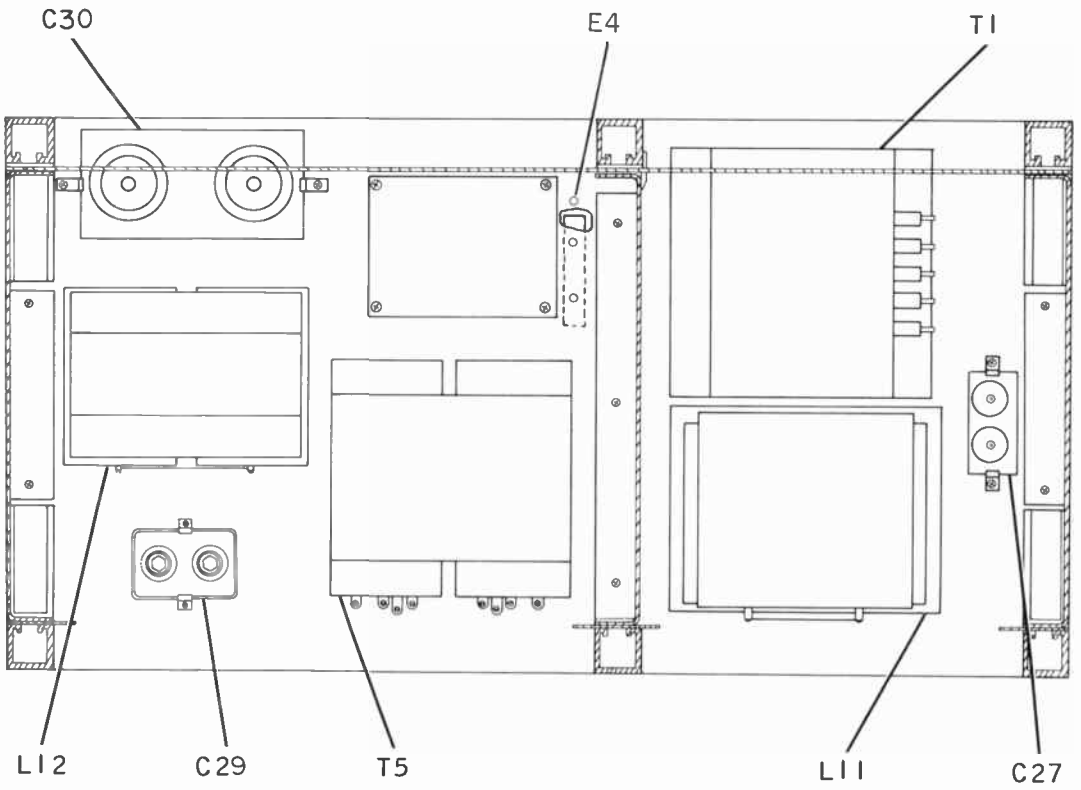


Figure 6-1. 820D-1 AM Broadcast Transmitter (Sheet 4 of 12).



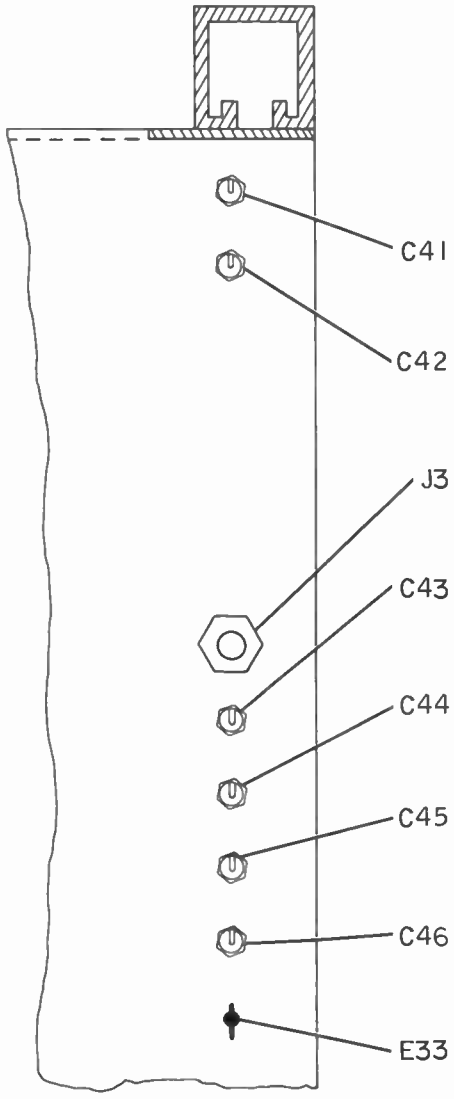
SECTION D-D

Figure 6-1. 820D-1 AM Broadcast Transmitter (Sheet 5 of 12).



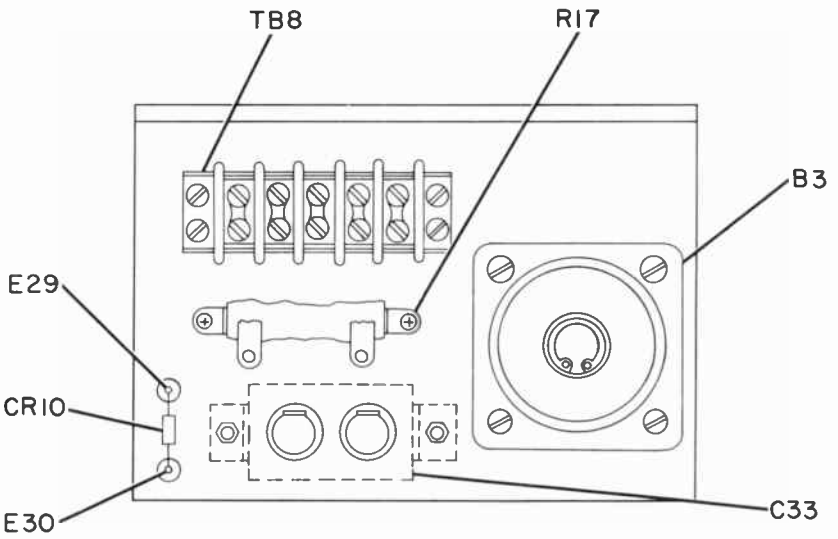
SECTION E-E

Figure 6-1. 820D-1 AM Broadcast Transmitter (Sheet 6 of 12).

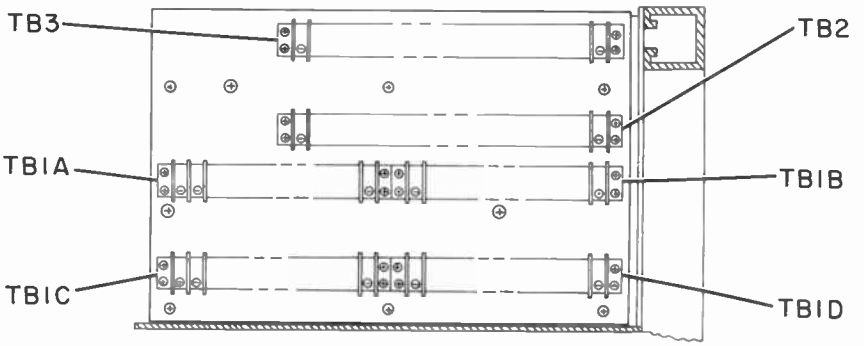


SECTION F-F

Figure 6-1. 820D-1 AM Broadcast Transmitter (Sheet 7 of 12).



DETAIL A



DETAIL B

Figure 6-1. 820D-1 AM Broadcast Transmitter (Sheet 8 of 12).

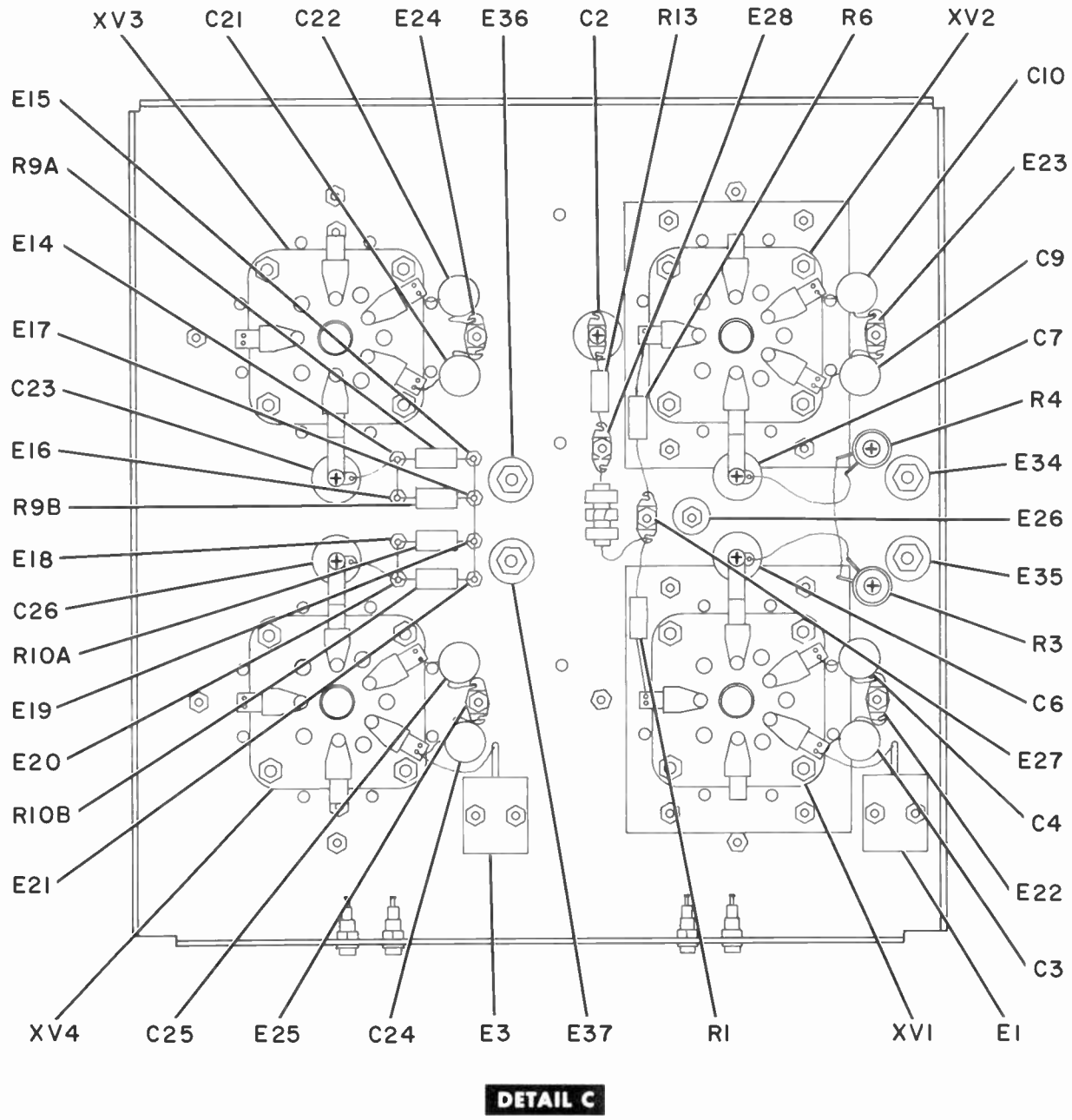


Figure 6-1. 820D-1 AM Broadcast Transmitter (Sheet 9 of 12).

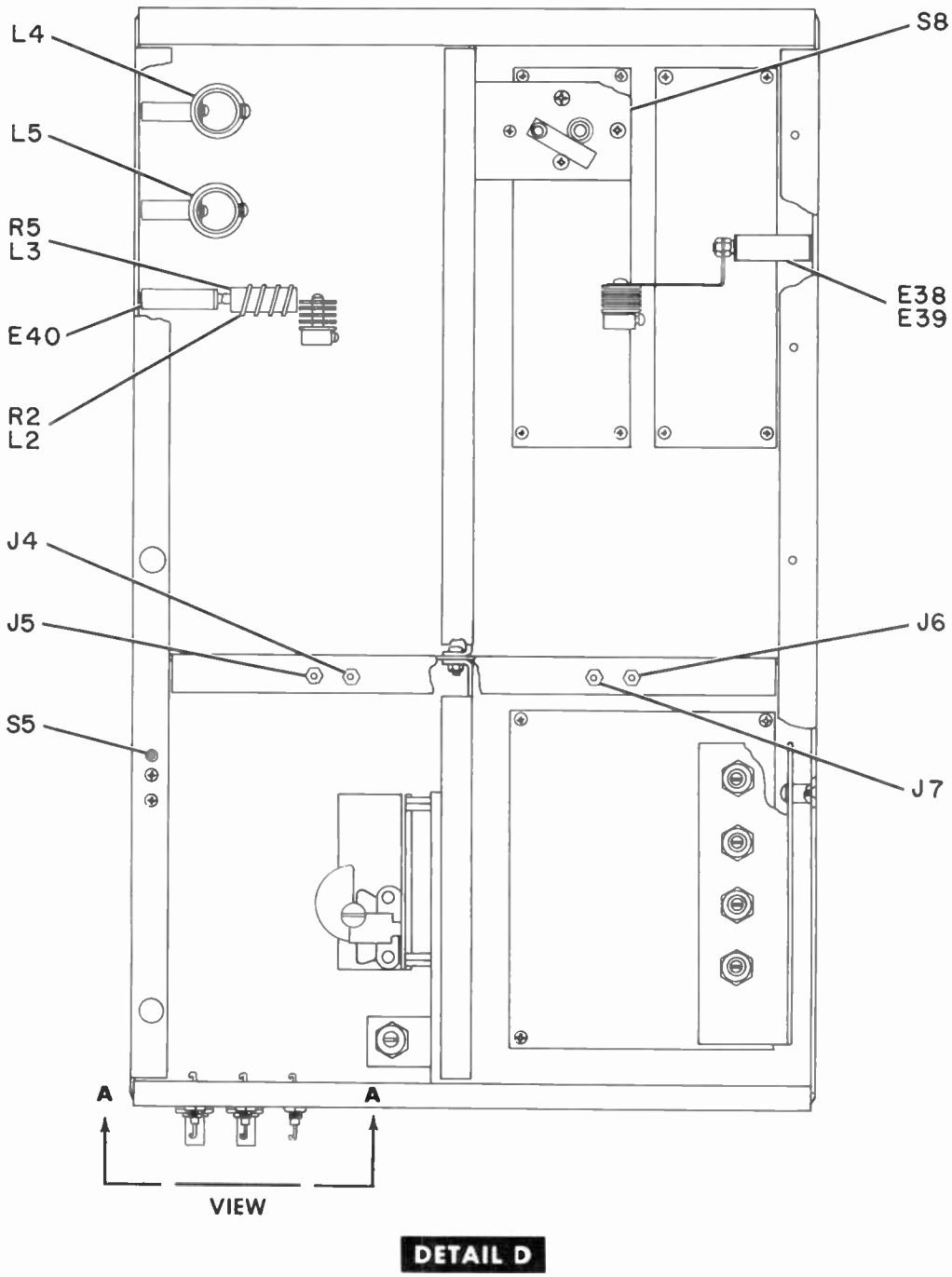


Figure 6-1. 820D-1 AM Broadcast Transmitter (Sheet 10 of 12).

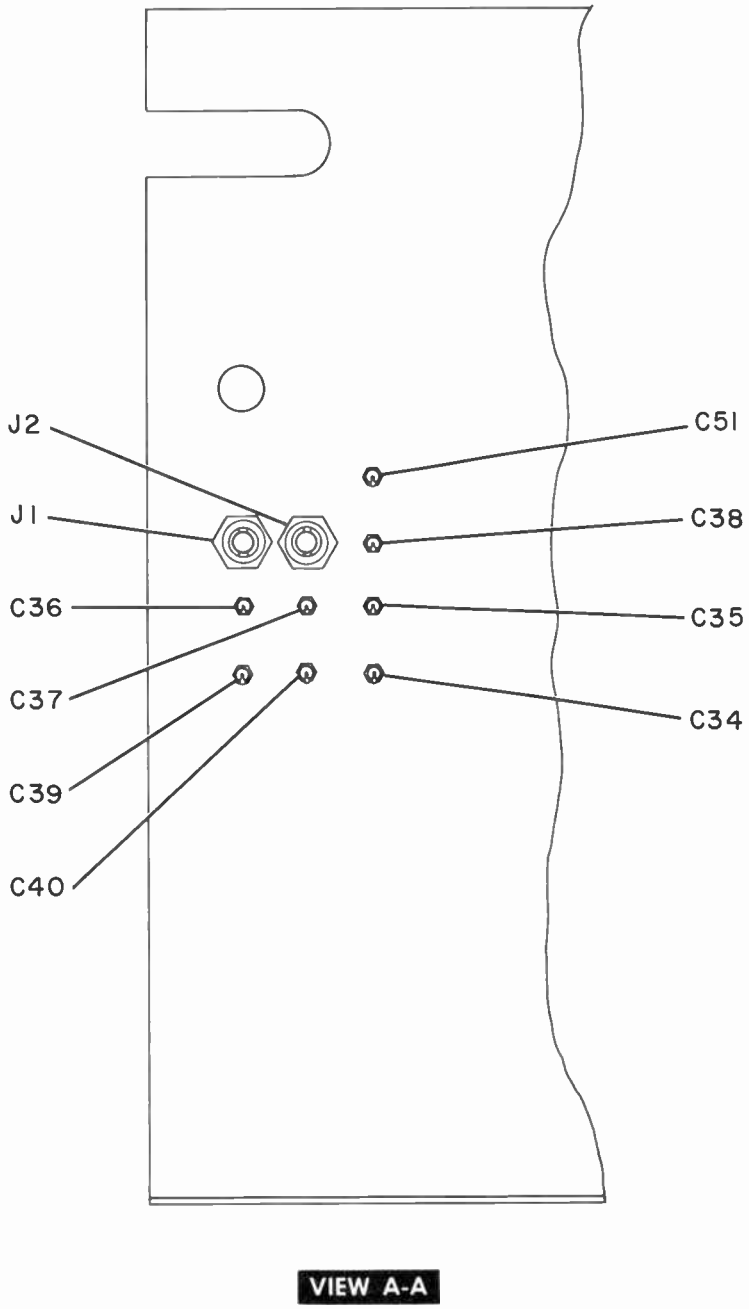
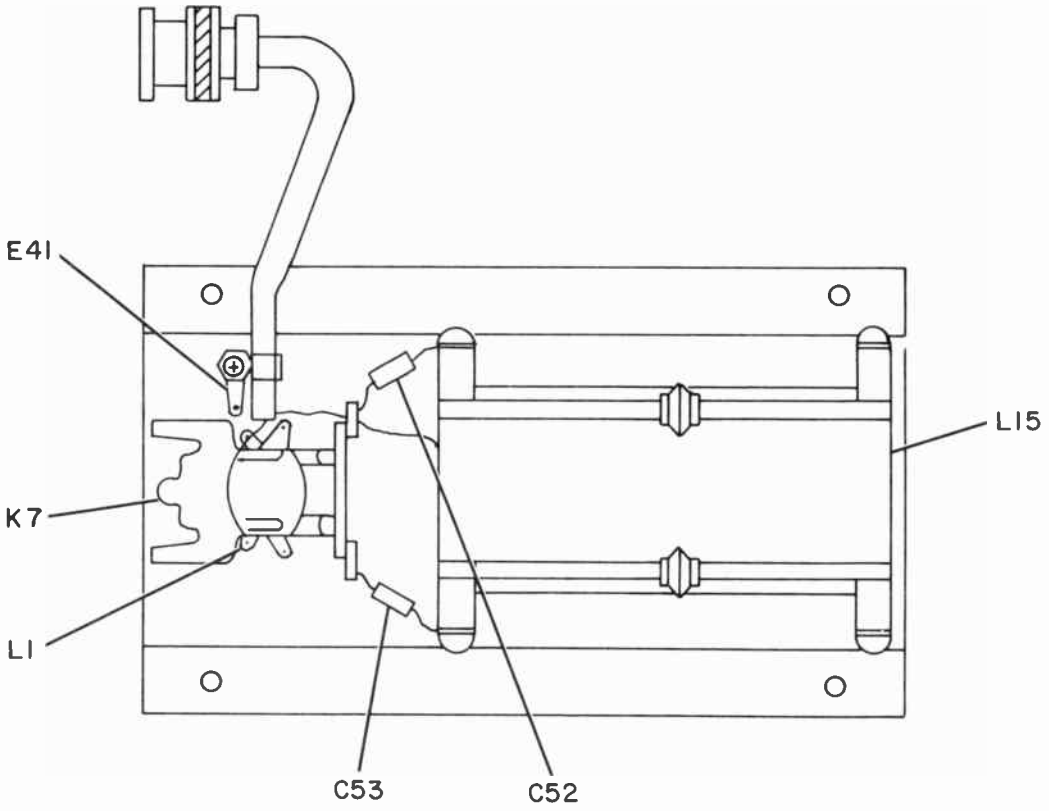


Figure 6-1. 820D-1 AM Broadcast Transmitter (Sheet 11 of 12).



DETAIL E

Figure 6-1. 820D-1 AM Broadcast Transmitter (Sheet 12 of 12).

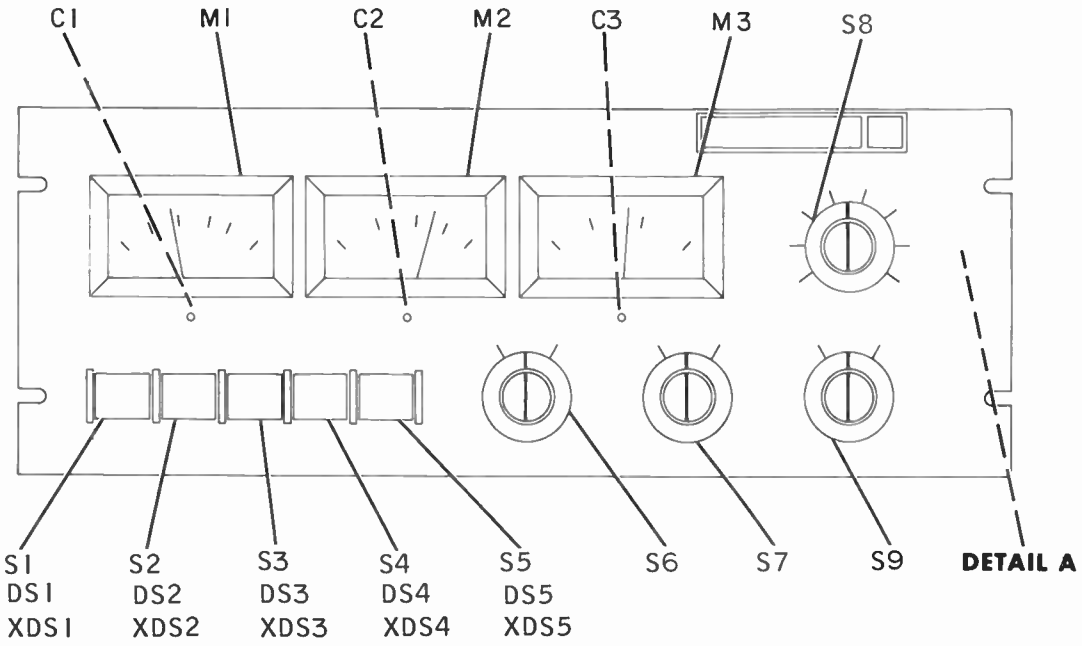
SYMBOL	DESCRIPTION	MANUFACTURER'S PART NUMBER	MFR CODE	COLLINS PART NUMBER
	B20D-1 AM BROADCAST TRANSMITTER			522-3391-XXX
A1	EXTENDED CONTROL PANEL SEE BREAKDOWN ON PAGE 6-19			771-9208-001
A2	REMOTE CONTROL RELAY BOARD			771-9265-001
A2A1	REMOTE CONTROL RELAY BOARD SEE BREAKDOWN ON PAGE 6-22			771-9256-001
A2A2	REMOTE CONTROL RELAY BOARD SEE BREAKDOWN ON PAGE 6-22			771-9250-001
A3	AUDIO DRIVER SEE BREAKDOWN ON PAGE 6-25			783-9568-001
A4	MODULATOR FEEDBACK DIVIDER SEE BREAKDOWN ON PAGE 6-28			783-9548-001
A5	SAME AS A4			
A6	POWER CONTROL SERVO AMPLIFIER SEE BREAKDOWN ON PAGE 6-30			771-9279-001
A7	TUNING/POWER CONTROL BOARD SEE BREAKDOWN ON PAGE 6-33			771-9070-001
A8	POWER CONTROL SENSOR SEE BREAKDOWN ON PAGE 6-35			771-9207-001
A9	PLATE VOLTAGE METER MULTIPLIER SEE BREAKDOWN ON PAGE 6-37			771-9248-001
A10	310W-1 AM BROADCAST EXCITER SEE SEPERATE PUBLICATION			758-5207-001
A11	RF DRIVER SEE BREAKDOWN ON PAGE 6-39			771-9198-001
A12	28V SUPPLY SEE BREAKDOWN ON PAGE 6-41			771-9196-001
A13	BIAS SUPPLY SEE BREAKDOWN ON PAGE 6-43			771-9206-001
A14	SCREEN SUPPLIES SEE BREAKDOWN ON PAGE 6-45			771-9165-001
A15	FILAMENT/CATHODE CIRCUITS SEE BREAKDOWN ON PAGE 6-48			771-9194-001
A16	MODULATOR CONTROL SEE BREAKDOWN ON PAGE 6-50			771-9277-001
A17	MODULATOR FEEDBACK DIVIDER SEE BREAKDOWN ON PAGE 6-52			771-9254-001
B1	BLOWER, CENTRIFUGAL			009-~~1860~~-010 009-2209-010 NEW P/N
B2	SELECT B2 FROM THE FOLLOWING LIST			
	FAN, TUBEAXIAL 115 VRMS, 60HZ	TN3A2	82877	009-1844-010
	FAN, TUBEAXIAL 115 VRMS, 50HZ	TN2A2	82877	009-1844-020
B3	MOTOR, FAN 115V, 1 WATT	FPE21L28-13	17771	229-1034-210
B4	MOTOR, CONTROL 115V, 1 WATT	FPE21L28-9	17771	229-1035-350
C1	CAPACITOR, FXD, VACUUM 15 UUF, 10% TOL, 17K VDCW	X15-17N203	73905	919-0063-000
C2	CAPACITOR, FXD, CERAMIC 1000 UUF, 20% TOL, 5K VDCW	DA858-003	71590	913-0101-000
C3	CAPACITOR, FXD, CERAMIC 0.01 UF, 20% TOL, 1.6K VDCW	DD16-103	71590	913-3522-000
C4	SAME AS C3			
C5	NOT USED			
C6	SAME AS C2			
C7	SAME AS C2			
C8	NOT USED			
C9	SAME AS C3			
C10	SAME AS C3			
C11	CAPACITOR, FXD, MICA 750 UUF, 5% TOL, 1CK VDCW	380MB751X5103S1	56289	912-4126-130

SYMBOL	DESCRIPTION	MANUFACTURER'S PART NUMBER	MFR CODE	COLLINS PART NUMBER
C12	CAPACITOR, FXD, MICA 510 UUF, 5% TOL, 1CK VDCW	380MB511X5103S1	56289	912-4126-010
C13	CAPACITOR, VARIABLE 25-50C UF, 10K VDCW			919-0129-000
C14	SELECT C14 FROM THE FOLLOWING LIST			
	CAPACITOR, FXD, MICA 240 UUF, 5% TOL, 1CK VDCW	380MB241X5103S1	56289	912-4126-100
	CAPACITOR, FXD, MICA 180 UUF, 5% TOL, 1CK VDCW	380MB181X5103S1	56289	912-4126-090
C15	CAPACITOR, FXD, MICA 240 UUF, 5% TOL, 1CK VDCW	380MB241X5103S1	56289	912-4126-100
C16	SELECT C16 FROM THE FOLLOWING LIST			
	CAPACITOR, FXD, MICA 3900 UUF, 5% TOL, 6K VDCW	375MB392X5602S1	56289	912-4140-180
	CAPACITOR, FXD, MICA 3000 UUF, 5% TOL, 6K VDCW	375MB302X5602S1	56289	912-4140-170
	CAPACITOR, FXD, MICA 2400 UUF, 5% TOL, 6K VDCW	375MB242X5602S1	56289	912-4140-160
	CAPACITOR, FXD, MICA 2000 UUF, 5% TOL, 6K VDCW	375MB202X5602S1	56289	912-4140-150
	CAPACITOR, FXD, MICA 1600 UUF, 5% TOL, 6K VDCW	375MB162X5602S1	56289	912-4140-140
C17	SAME AS C16			
C18	SAME AS C16			
C19	SAME AS C16			
C20	NOT USED			
C21	SAME AS C3			
C22	SAME AS C3			
C23	SAME AS C2			
C24	SAME AS C3			
C25	SAME AS C3			
C26	SAME AS C2			
C27	CAPACITOR, FXD, PAPER 1 UF, 10% TOL, 4K VDCW			930-0333-000
C28	CAPACITOR, FXD, ELECTROLYTIC 1500 UF, PLUS 150% MINUS 10%, 50 VDCW	539-2552-01	53021	183-1297-010
C29	CAPACITOR, FXD, PAPER 0.08 UF, 5% TOL, 2.4K VDCW	92460	56289	930-0467-000
C30	CAPACITOR, FXD, PAPER 20 UF, 10% TOL, 4K VDCW	702013-0701	53021	930-0774-030
C31	SAME AS C28			
C32	CAPACITOR, FXD, PAPER 2 UF, 10% TOL, 600 VDCW	CP70B1EF205K	81349	962-4461-000
C33	SAME AS C32			
C34	CAPACITOR, FXD, CERAMIC 1000 UUF, PLUS 80% MINUS 20%, 500 VDCW	327-029X5T0102Z	72982	913-1292-000
C35 THROUGH C46	SAME AS C34			
C47	CAPACITOR, FXD, CERAMIC 0.1 UF, PLUS 80% MINUS 20%, 200 VDCW	33C142A1	56289	913-3681-000
C48	SAME AS C47			
C49	SAME AS C47			
C50	CAPACITOR, FXD, CERAMIC 0.1 UF, PLUS 80% MINUS 20%, 500 VDCW	41C92	01939	913-3152-000
C51	SAME AS C34			
C52	CAPACITOR, FXD, MICA 330 UUF, 5% TOL, 500 VDCW	CM05FD331J03	81349	912-2852-000
C53	SAME AS C52			
CB1	CIRCUIT BREAKER 6-AMP CURRENT RATING	12MC105-6	82647	260-4052-040
CB2	CIRCUIT BREAKER 50-AMP CURRENT RATING			260-0952-050

SYMBOL	DESCRIPTION	MANUFACTURER'S PART NUMBER	MFR CODE	COLLINS PART NUMBER
CR1	SEMICONDUCTOR DEVICE, DIODE	F587-1	13327	353-0413-010
CR2	SAME AS CR1			
CR3	SAME AS CR1			
CR4	SAME AS CR1			
CR5	NOT USED			
CR6	SEMICONDUCTOR DEVICE, DIODE	1N645	72699	353-2607-000
CR7	NOT USED			
CR8 THROUGH CR11	SAME AS CR6			
E1	SPARK GAP			762-8880-001
E2	SAME AS E1			
E3	SAME AS E1			
E4	SCREW, MACHINE NO. 1/4-20 X 1 IN. LG.	P343-0370-0D	77250	343-0370-000
E5	TERMINAL, STUD	RTMT12M	91663	306-C976-000
E6	SAME AS E5			
E7	SAME AS E5			
E8	SAME AS E5			
E9	TERMINAL, LUG	2104-06-02-2520N	78189	304-0318-000
E10 THROUGH E13	NOT USED			
E14 THROUGH E21	SAME AS E5			
E22	TERMINAL, LUG	2110-06-00HCTTIN NED	78189	304-2720-000
E23	SAME AS E22			
E24	SAME AS E22			
E25	SAME AS E22			
E26	TERMINAL, FEEDTHRU			762-8843-001
E27	TERMINAL, CERAMIC	E1706	70371	190-1144-000
E28	SAME AS E27			
E29 THROUGH E32	SAME AS E5			
E33	TERMINAL, LUG	2104-08-02-2520N	78189	304-C319-000
E34	TERMINAL, CERAMIC	E1013	70371	190-1159-000
E35	SAME AS E34			
E36	SAME AS E34			
E37	SAME AS E34			
E38	TERMINAL, CERAMIC	E1709	70371	190-1146-000
E39	SAME AS E38			
E40	SAME AS E38			
E41	SAME AS E5			
F1	FUSE, CARTRIDGE 1-AMP CURRENT RATING	AGC250-1	71400	264-C721-000
F2	FUSE, CARTRIDGE 1/32-AMP CURRENT RATING	AGC250-1-32	71400	264-0710-000
J1	CONNECTOR, ELECTRICAL 1 CONTACT	UG492DU	80058	357-9332-000
J2	SAME AS J1			
J3	SAME AS J1			
J4	JACK, TIP BLACK	MS16108-3A	96906	360-0151-000
J5	JACK, TIP RED	MS16108-2A	96906	360-0150-000
J6	SAME AS J4			
J7	SAME AS J5			
K1	RELAY, ARMATURE 2-C NORMALY CLOSED 5-S NORMALY OPEN	E52,28 VDC	52090	401-C002-230
K2	SAME AS K1			
K3	RELAY, ARMATURE 1C CONTACT ARRANGEMENT	A8581	71482	97C-2453-090
K4	NOT USED			
K5	RELAY, ARMATURE 2A CONTACT ARRANGEMENT	B220-22-75N	52090	401-1261-03C
K6	SAME AS K5			
K7	RELAY, ARMATURE 2C CONTACT ARRANGEMENT	KR3228	77342	97C-2437-08C

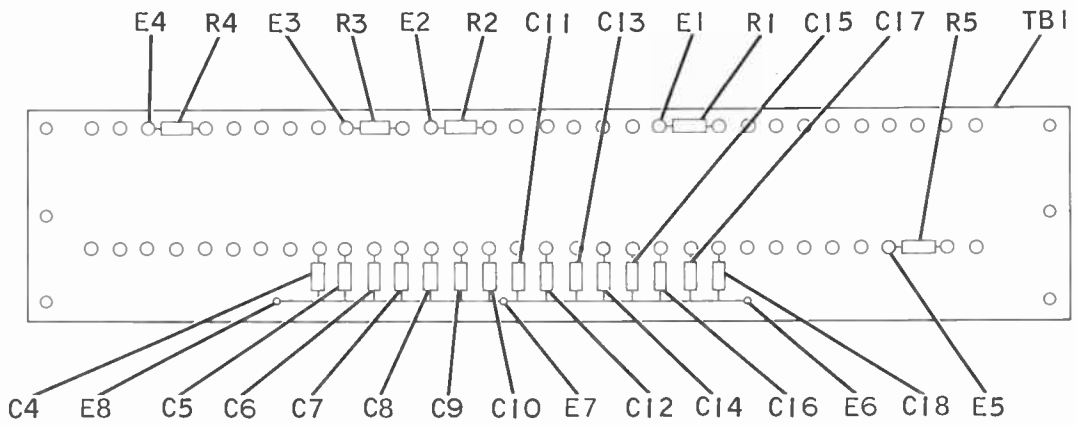
SYMBOL	DESCRIPTION	MANUFACTURER'S PART NUMBER	MFR CODE	COLLINS PART NUMBER
L1	CHOKE, RF 10 MH, 5% TOL	R50-10	07886	240-2720-010
L2	INDUCTOR, RF 0.17 UH			762-8820-001
L3	SAME AS L2			
L4	INDUCTOR, RF 2.5 MH			571-0460-100
L5	SAME AS L4			
L6	INDUCTOR, RF 100 UH,	200-308	74970	980-0051-000
L7	INDUCTOR, RF 22 UH,	200-307	74970	980-0133-000
L8	INDUCTOR, RF 82 UH,	200-104	74970	980-0047-000
L9	INDUCTOR, RF 15 UH,	200-306	74970	980-0132-000
L10	INDUCTOR, RF 17 MH,			762-8800-002
L11	INDUCTOR, RF 50 H	29955	97965	678-C591-000
L12	INDUCTOR, RF 10 H	19069	97965	678-0625-000
L13	NOT USED			
L14	NOT USED			
L15	INDUCTOR, RF 60 UH,			549-5098-004
R1	RESISTOR, FXD, COMPOSITION 47 OHMS, 10% TOL, 2 WATTS	RC42GF470K	81349	745-5596-000
R2	RESISTOR, FXD, COMPOSITION 50 OHMS, 10% TOL, 16.5 WATTS	780SP2	10646	712-0129-000
R3	RESISTOR, FXD, WIRE WOUND 2K OHMS, 5% TOL, 25 WATTS	0207	44655	71C-4777-000
R4	SAME AS R3			
R5	SAME AS R2			
R6	SAME AS R1			
R7	RESISTOR, FXD, WIRE WOUND 2.5K OHMS, 5% TOL, 100 WATTS			710-0128-000
R8	RESISTOR, FXD, WIRE WOUND 180 OHMS, 5% TOL, 10 WATTS	1-3-4057F180	44655	71C-2937-000
R9A	RESISTOR, FXD, COMPOSITION 100 OHMS, 10% TOL, 2 WATTS	RC42GF101K	81349	745-5610-000
R9B	SAME AS R9A			
R10A	SAME AS R9A			
R10B	SAME AS R9A			
R11	RESISTOR, FXD, WIRE WOUND 82K OHMS, 5% TOL, 210 WATTS	RW47V823	81349	746-6837-000
R12	SAME AS R9A			
R13	RESISTOR, FXD, COMPOSITION 220 OHMS, 10% TOL, 2 WATTS	RC42GF221K	81349	745-5624-000
R14	RESISTOR, FXD, WIRE WOUND 15 OHMS, 10% TOL, 75 WATTS	0771	44655	716-0055-090
R15	RESISTOR, FXD, WIRE WOUND 50 OHMS, 10% TOL, 75 WATTS	1109	44655	735-0363-100
R16	SAME AS R15			
R17	RESISTOR, FXD, WIRE WOUND 220 OHMS, 5% TOL, 10 WATTS			710-0199-000
R18	SAME AS R17			
S1	SWITCH, INTERLOCK 1C CONTACT ARRANGEMENT	1000	82877	266-8309-000
S2	SWITCH, INTERLOCK 1C CONTACT ARRANGEMENT	2000	82877	266-8312-000
S3	SWITCH, INTERLOCK 1C CONTACT ARRANGEMENT	2AC2	91929	266-0013-000
S4	SAME AS S3			
S5	SAME AS S3			

SYMBOL	DESCRIPTION	MANUFACTURER'S PART NUMBER	MFR CODE	COLLINS PART NUMBER
S6	SAME AS S2			
S7	SWITCH, GROUNDING			771-9241-001
S8	SWITCH, GROUNDING			783-9541-001
S9	SAME AS S8			
T1	TRANSFORMER, AF OPEN FRAME, LEAD 1 TO 3 19K OHMS IMPEDANCE, LEAD 4 TO 5 37K OHMS IMPEDANCE, LEAD 2 CENTER TAP	E11585A	80008	667-0497-000
T2	SELECT T2 FROM THE FOLLOWING LIST			
	TRANSFORMER, POWER 60HZ, 236V, 5COW	23-26-150	55814	662-0292-030
	TRANSFORMER, POWER 50HZ, 236V, 5COW	23-26-650	55814	662-0292-040
T3	TRANSFORMER, VARIAC			664-4015-010
T4	TRANSFORMER, POWER 30 V, 15A			662-0365-010
T5	TRANSFORMER, POWER, STEP-UP OPEN FRAME	H9445	81416	662-0285-010
TB1A	BOARD, TERMINAL 13 TERMINALS	13-141Y	75173	367-0111-000
TB1B	SAME AS TB1A			
TB1C	SAME AS TB1A			
TB1D	SAME AS TB1A			
TB2	BOARD, TERMINAL 20 TERMINALS	20-141Y	75173	367-0118-000
TB3	SAME AS TB2			
TB4	BOARD, TERMINAL 2 TERMINALS	2-141	71785	367-4020-000
TB5	BOARD, TERMINAL 3 TERMINALS	3-150	75173	367-7030-000
TB6	BOARD, TERMINAL 4 TERMINALS	4-141	75173	367-4040-000
TB7	SAME AS TB4			
TB8	BOARD, TERMINAL 5 TERMINALS	5-141	71785	367-4050-000
TB9	BOARD, TERMINAL 6 TERMINALS	6-141	71785	367-4060-000
TB10	SAME AS TB6			
V1	ELECTRON TUBE	5-500A	82219	257-0600-020
V2	SAME AS V1			
V3	SAME AS V1			
V4	SAME AS V1			
XF1	FUSEHOLDER	HKLEX	71400	265-1241-090
XF2	SAME AS XF1			
XV1	SOCKET, ELECTRON TUBE 5 CONTACTS	275	74970	220-1016-000
XV2	SAME AS XV1			
XV3	SAME AS XV1			
XV4	SAME AS XV1			



FRONT VIEW

Figure 6-2. Extended Control Panel A1 (Sheet 1 of 2).



DETAIL A

Figure 6-2. Extended Control Panel A1 (Sheet 2 of 2).

SYMBOL	DESCRIPTION	MANUFACTURER'S PART NUMBER	MFR CODE	COLLINS PART NUMBER
	EXTENDED CONTROL PANEL A1			771-9208-001
C1	CAPACITOR, FXD, CERAMIC 0.1 UF, PLUS 80% MINUS 20%, 200 VDCW	825-213X5V0104Z	72982	913-3681-000
C2 THROUGH C13	SAME AS C1			
DS1	LAMP, INCANDESCENT 28 VOLTS, 0.04 AMP	MS25237-327	96906	262-0179-000
DS2 THROUGH DS5	SAME AS DS1			
E1 E2 THROUGH E8	TERMINAL, STUD SAME AS E1	306-0974-00	21537	306-0974-000
M1	AMMETER, DC 0-1 MA			458-0783-140
M2	AMMETER, DC 0-2 MA			458-0783-110
M3	AMMETER, DC 0-1 MA	253491	65092	458-0783-050
R1	RESISTOR, FXD, COMPOSITION 39 OHMS, 10% TOL, 1 WATT	RC32GF390K	81349	745-3293-000
R2 THROUGH R5	SAME AS R1			
S1	SWITCH, PUSH BUTTON 1C CONTACT ARRANGEMENT	12-327	96182	266-6806-100
S2	SAME AS S1			
S3	SAME AS S1			
S4	SWITCH, PUSH BUTTON 3PDT CONTACT ARRANGEMENT	12-338	96182	266-6806-730
S5	SAME AS S4			
S6	SWITCH, ROTARY 1 SECTION, 2 POLES, 3 POSITIONS	242752H1	76854	259-1980-000
S7	SAME AS S6			
S8	SWITCH, ROTARY 2 POLES, 8 POSITIONS	5002-8	81073	259-2673-120
S9	SWITCH, ROTARY 1 SECTION, 1 POLE, 2 POSITIONS	210786H1	76854	259-1321-000
TB1	BOARD, TERMINAL 52 TERMINALS			771-8984-001
XDS1 XDS2 THROUGH XDS5	SWITCH MOUNT SAME AS XDS1	12-1	96182	266-6806-010

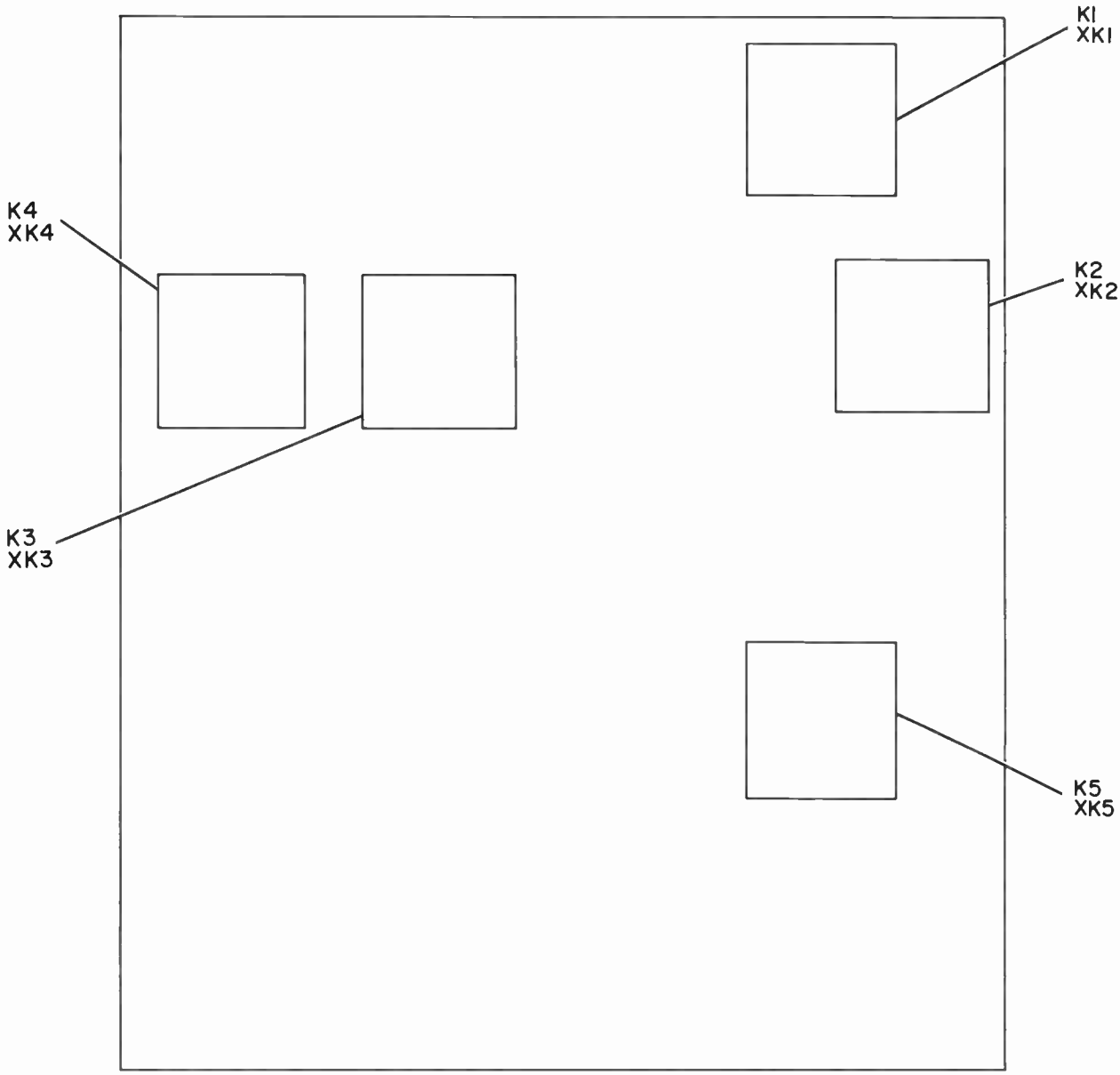


Figure 6-3. Remote Control Relay Board A2A1.

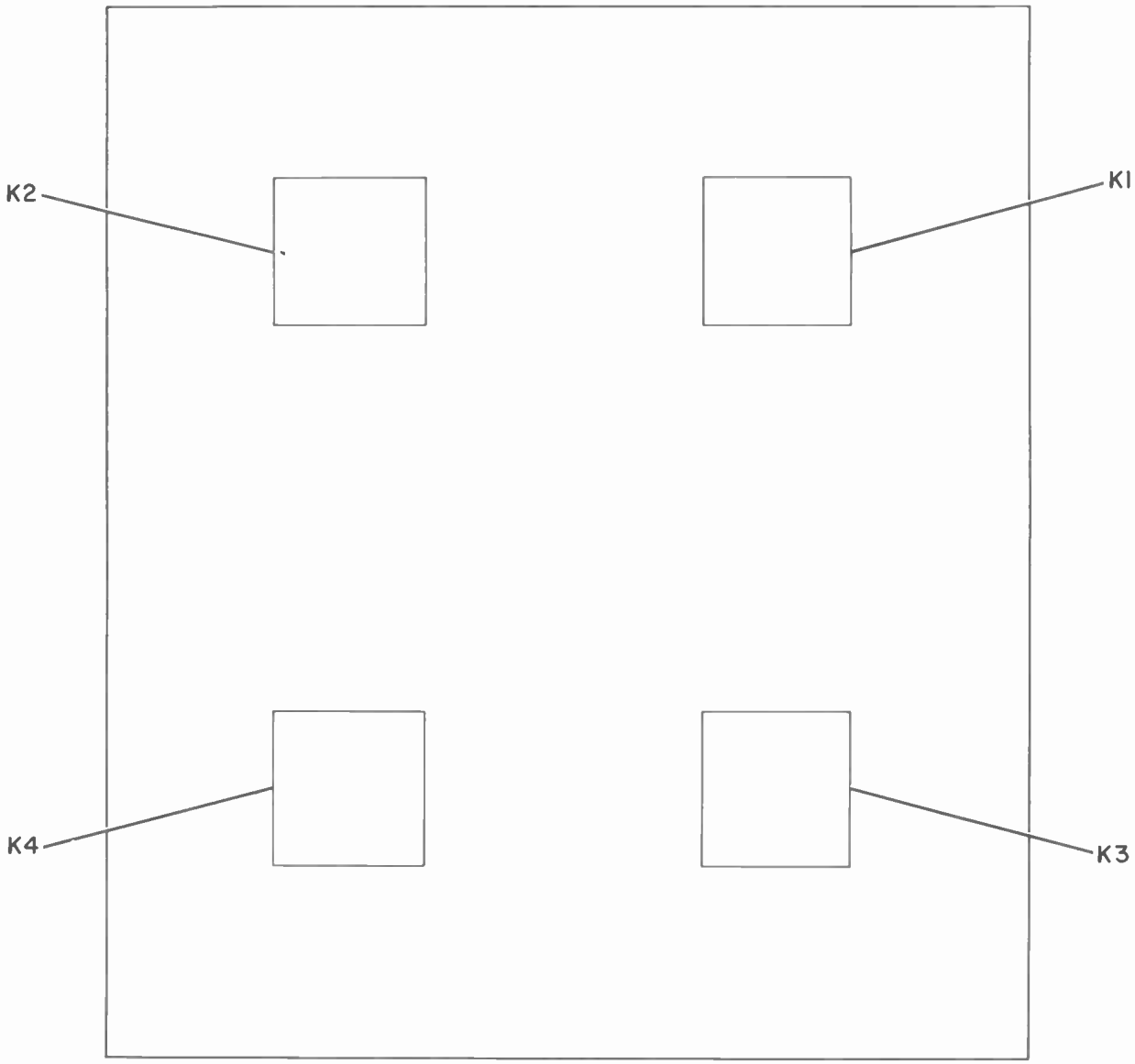
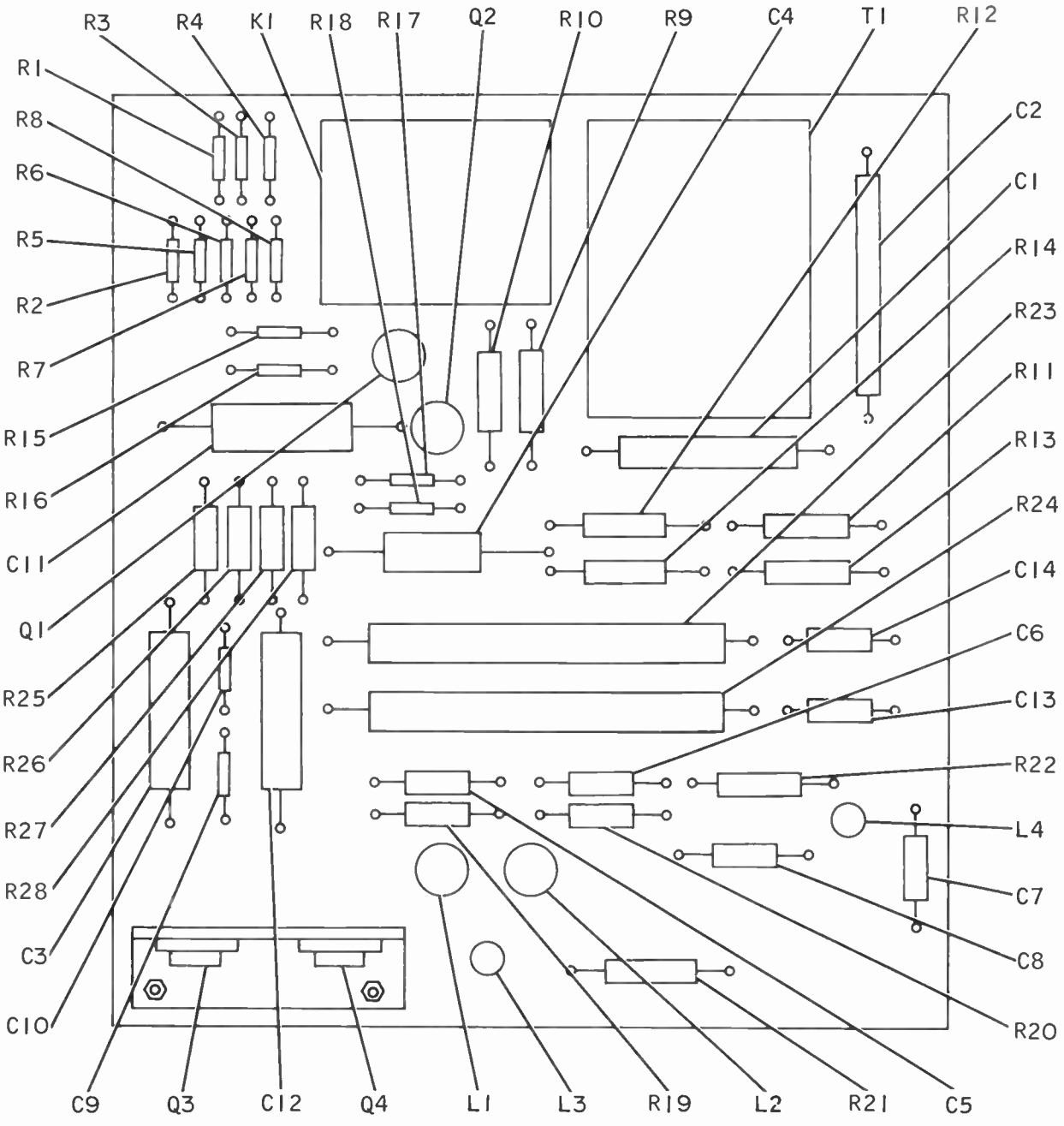


Figure 6-4. Remote Control Relay Board A2A2.

SYMBOL	DESCRIPTION	MANUFACTURER'S PART NUMBER	MFR CODE	COLLINS PART NUMBER
	REMOTE CONTROL RELAY BOARD A2A1 REMOTE CONTROL RELAY BOARD A2A2			771-9256-001 771-9250-001
K1	RELAY, ARMATURE 2A, 1B CONTACT ARRANGEMENT	93-919454-23615A	80089	970-2454-440
K2	SAME AS K1			
K3	SAME AS K1			
K4	SAME AS K1			
K5	RELAY, ARMATURE 2A, 1B CONTACT ARRANGEMENT -USED ON A2A1 ONLY-	93-919454-23615A	80089	970-2454-440
XK1	SOCKET, RELAY 8 TERMINALS			771-9243-001
XK2	SAME AS XK1			
XK3	SAME AS XK1			
XK4	SAME AS XK1			
XK5	SOCKET, RELAY 8 TERMINALS -USED ON A2A1 ONLY-			771-9243-001



B301 623 Bx

Figure 6-5. Audio Driver A3.

SYMBOL	DESCRIPTION	MANUFACTURER'S PART NUMBER	MFR CODE	COLLINS PART NUMBER
	AUDIO DRIVER A3			783-9568-001
C1	CAPACITOR, FXD, MICA 0.024 UF, 1% TOL, 500 VDCW	CM08FD243J03	81349	912-3124-000
C2	SAME AS C1			
C3	CAPACITOR, FXD, ELECTROLYTIC 20 UF, PLUS 100% MINUS 10%, 50 VDCW	D29741	56289	183-1169-00C
C4	SAME AS C3			
C5	CAPACITOR, FXD, MICA 2700 UUF, 5% TOL, 500 VDCW	CM06FD272J03	81349	912-3034-000
C6	SAME AS C5			
C7	CAPACITOR, FXD, MICA 6800 UUF, 5% TOL, 500 VDCW	CM07FD682J03	81349	912-2723-00C
C8	SAME AS C7			
C9	CAPACITOR, FXD, MICA 120 UUF, 5% TOL, 500 VDCW	CM05FD121J03	81349	912-2822-00C
C10	SAME AS C9			
C11	CAPACITOR, FXD, PAPER 0.047 UF, 20% TOL, 30 VDCW	196P47303S4	56289	931-4526-000
C12	SAME AS C11			
C13	CAPACITOR, FXD, MICA 3900 UUF, 5% TOL, 500 VDCW	CM06FD392J03	81349	912-3046-000
C14	SAME AS C13			
K1	RELAY, ARMATURE 3C CONTACT ARRANGEMENT	93-502999-23300A	80089	970-2454-480
L1	COIL, RF 5 MH, 5% TOL	FL511	80223	24C-2184-00C
L2	SAME AS L1			
L3	COIL, RF 22 MH, 5% TOL	19-225	80483	24C-2576-CCC
L4	SAME AS L3			
Q1	TRANSISTOR	2N697	04713	352-0197-000
Q2	SAME AS Q1			
Q3	TRANSISTOR	2N3585	02735	352-0711-03C
Q4	SAME AS Q3			
R1	RESISTOR, FXD, COMPOSITION 180 OHMS, 5% TOL, 1/2 WATT	RC20GF181J	81349	745-1320-000
R2	SAME AS R1			
R3	RESISTOR, FXD, COMPOSITION 330 OHMS, 5% TOL, 1/2 WATT	RC20GF331J	81349	745-1330-000
R4	SAME AS R1			
R5	SAME AS R1			
R6	SELECT R6 FROM THE FOLLOWING LIST			
	RESISTOR, FXD, COMPOSITION 160 OHMS, 5% TOL, 1/2 WATT	RC20GF161J	81349	745-1319-000
	RESISTOR, FXD, COMPOSITION 100 OHMS, 5% TOL, 1/2 WATT	RC20GF101J	81349	745-1309-000
R7	SELECT R7 FROM THE FOLLOWING LIST			
	RESISTOR, FXD, COMPOSITION 1K OHMS, 5% TOL, 1/2 WATT	RC20GF102J	81349	745-1351-000
	RESISTOR, FXD, COMPOSITION 1800 OHMS, 5% TOL, 1/2 WATT	RC20GF182J	81349	745-1362-000
R8	SAME AS R6			
R9	RESISTOR, FXD, FILM 1K OHMS, 1% TOL, 1/2 WATT	RN65D1001F	81349	7C5-7096-000
R10	SAME AS R9			
R11	RESISTOR, FXD, FILM 2.21K OHMS, 1% TOL, 1/2 WATT	RN65D2211F	81349	7C5-7264-000
R12	SAME AS R11			
R13	RESISTOR, FXD, FILM 46.4K OHMS, 1% TOL, 1/2 WATT	RN65D4642F	81349	7C5-7176-000
R14	SAME AS R13			

SYMBOL	DESCRIPTION	MANUFACTURER'S PART NUMBER	MFR CODE	COLLINS PART NUMBER
R15	RESISTOR, FXD, COMPOSITION 120 OHMS, 10% TOL, 1/2 WATT	RC20GF121K	81349	745-1314-000
R16	SAME AS R15			
R17	RESISTOR, FXD, COMPOSITION 3900 OHMS, 5% TOL, 1/2 WATT	RC20GF392J	81349	745-1376-000
R18	SAME AS R17			
R19	RESISTOR, FXD, COMPOSITION 68 OHMS, 10% TOL, 1/2 WATT	RC20GF680K	81349	745-1303-000
R20	SAME AS R19			
R21	RESISTOR, FXD, FILM 3160 OHMS, 1% TOL, 1/2 WATT	RN65D3161F	81349	7C5-7120-000
R22	SAME AS R21			
R23	RESISTOR, FXD, FILM 250K OHMS, 1% TOL, 2 WATTS	RN80B2503F	81349	7C5-1457-090
R24	SAME AS R23			
R25	RESISTOR, FXD, FILM 4220 OHMS, 1% TOL, 1/2 WATT	RN65D4221F	81349	7C5-7126-000
R26	SAME AS R25			
R27	RESISTOR, FXD, FILM 511 OHMS, 1% TOL, 1/2 WATT	RN65D5110F	81349	7C5-7082-000
R28	SAME AS R27			
T1	TRANSFORMER, AF METAL CASED	124A31	11700	667-0187-030
XK1	SOCKET, RELAY 8 TERMINALS			771-9258-001
XQ1	SOCKET, TRANSISTOR 4 CONTACTS	3303	91662	352-9872-000
XQ2	SAME AS XQ1			

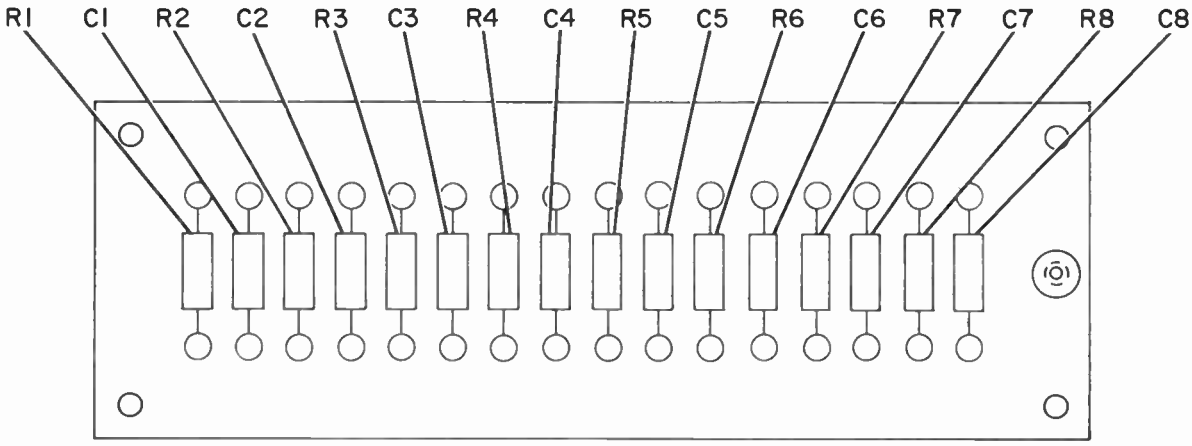


Figure 6-6. Modulator Feedback Divider A4.

SYMBOL	DESCRIPTION	MANUFACTURER'S PART NUMBER	MFR CODE	COLLINS PART NUMBER
	MODULATOR FEEDBACK DIVIDER A4			783-9548-001
C1	CAPACITOR, FXD, MICA 100 UUF, 5% TOL, 500 VDCW	DM10F101-1CR	72136	912-4907-000
C2 THROUGH C8	SAME AS C1			
R1	RESISTOR, FXD, COMPOSITION 820K OHMS, 5% TOL, 2 WATTS	RC42GF824K	81349	745-5774-000
R2 THROUGH R8	SAME AS R1			

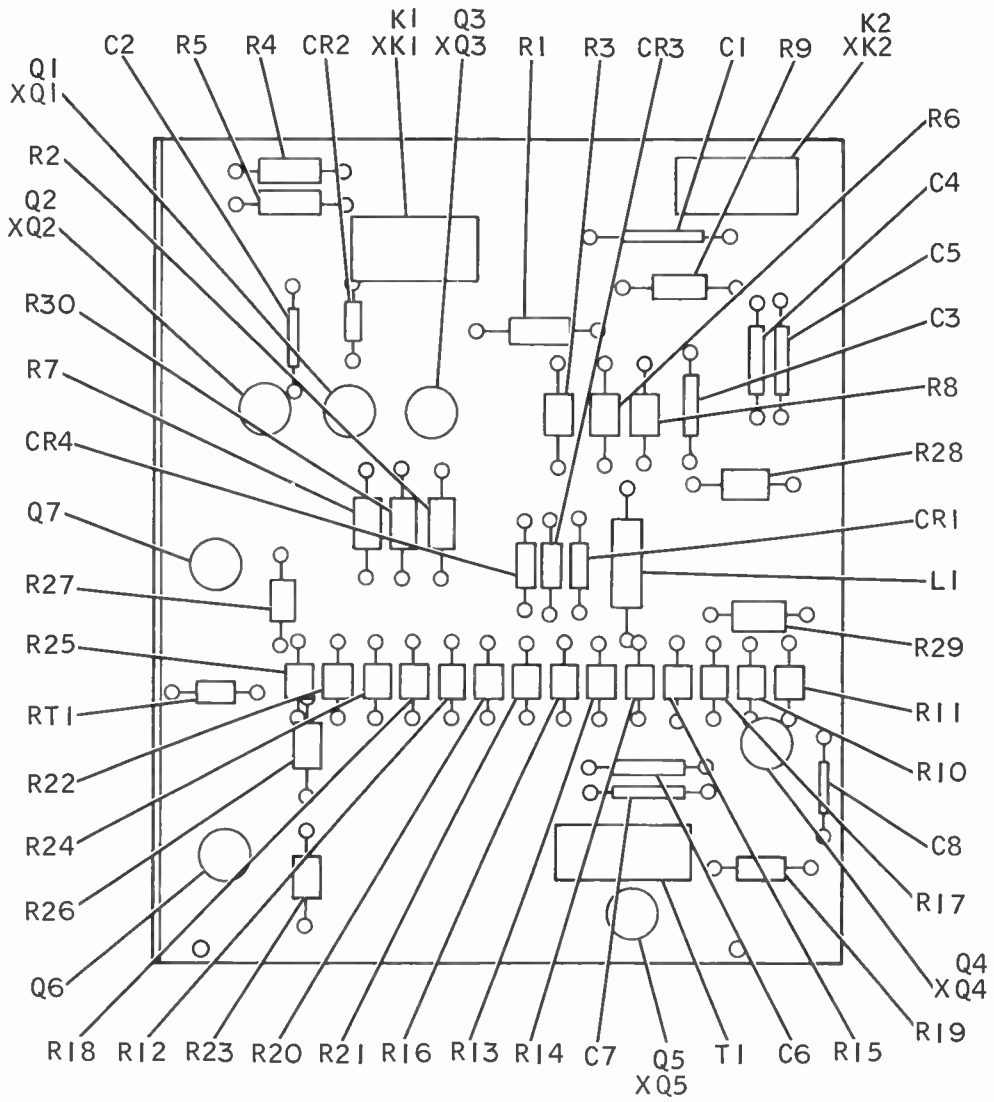


Figure 6-7. Power Control Servo Amplifier A6.

SYMBOL	DESCRIPTION	MANUFACTURER'S PART NUMBER	MFR CODE	COLLINS PART NUMBER
	POWER CONTROL SERVO AMPLIFIER A6			771-9279-001
C1	CAPACITOR, FXD, PAPER 0.068 UF, 5% TOL, 100 VDCW	196P68351S4	56289	931-5019-000
C2	SAME AS C1			
C3	SAME AS C1			
C4	CAPACITOR, FXD, ELECTROLYTIC 20 UF, PLUS 75% MINUS 15%, 25 VDCW	29F490G22	06001	184-7233-000
C5	CAPACITOR, FXD, CERAMIC 0.01 UF, PLUS 80% MINUS 20%, 100 VDCW	19C233A3	56289	913-3680-000
C6	CAPACITOR, FXD, ELECTROLYTIC 33 UF, 20% TOL, 10 VDCW	150D336X0010B2	56289	184-7382-000
C7	SAME AS C6			
C8	CAPACITOR, FXD, ELECTROLYTIC 2 UF, 20% TOL, 75 VDCW	29F586G22	06001	184-7929-000
CR1	SEMICONDUCTOR DEVICE, DIODE	1N30248	99942	353-3129-000
CR2	SEMICONDUCTOR DEVICE, DIODE	1N547	04713	353-1144-000
CR3	SAME AS CR1			
CR4	SEMICONDUCTOR DEVICE, DIODE	1N963A	04713	353-3220-000
K1	RELAY, ARMATURE 3C CONTACT ARRANGEMENT	93-502333-23300B	80089	970-2454-270
K2	SAME AS K1			
L1	CHOKE, RF 220 MH, 5% TOL	8S217	99800	240-0198-000
Q1	TRANSISTOR	2N930	03508	352-0517-010
Q2	TRANSISTOR	2N4220	04713	352-0740-010
Q3	TRANSISTOR	2N1711	03508	352-0400-000
Q4	SAME AS Q3			
Q5	TRANSISTOR	2N498	03508	352-0112-000
Q6	TRANSISTOR	2N1547A	04713	352-0419-000
Q7	SAME AS Q6			
R1	RESISTOR, FXD, FILM 1K OHMS, 5% TOL, 2 WATTS	RL42S102	81349	745-7124-000
R2	RESISTOR, FXD, COMPOSITION 10K OHMS, 10% TOL, 1/2 WATT	RC20GF103K	81349	745-1394-000
R3	RESISTOR, FXD, FILM 21.5K OHMS, 1% TOL, 1/2 WATT	RN65D2152F	81349	705-7160-000
R4	RESISTOR, FXD, FILM 46.4K OHMS, 1% TOL, 1/2 WATT	RN65D4642F	81349	705-7176-000
R5	SAME AS R4			
R6	RESISTOR, FXD, FILM 162K OHMS, 1% TOL, 1/4 WATT	RN65C1623F	81349	705-4614-000
R7	RESISTOR, FXD, COMPOSITION 10K OHMS, 10% TOL, 1/4 WATT	RC07GF103K	81349	745-0785-000
R8	RESISTOR, FXD, FILM 100K OHMS, 1% TOL, 1/4 WATT	RN65C1003F	81349	705-4609-000
R9	SAME AS R7			
R10	RESISTOR, FXD, COMPOSITION 5600 OHMS, 10% TOL, 1/2 WATT	RC20GF562K	81349	745-1384-000
R11	RESISTOR, FXD, COMPOSITION 22K OHMS, 10% TOL, 1/2 WATT	RC20GF223K	81349	745-1408-000
R12	RESISTOR, FXD, FILM 1 MEGOHM, 1% TOL, 1/2 WATT	RN65D1004F	81349	705-7240-000
R13	RESISTOR, FXD, COMPOSITION 6800 OHMS, 10% TOL, 1/2 WATT	RC20GF682K	81349	745-1387-000
R14	SAME AS R13			

SYMBOL	DESCRIPTION	MANUFACTURER'S PART NUMBER	MFR CODE	COLLINS PART NUMBER
R15	SAME AS R11			
R16	SAME AS R10			
R17	RESISTOR, FXD, COMPOSITION 1500 OHMS, 10% TOL, 1/2 WATT	RC20GF152K	81349	745-1359-000
R18	SAME AS R11			
R19	SAME AS R11			
R20	SAME AS R10			
R21	RESISTOR, FXD, COMPOSITION 22 OHMS, 10% TOL, 1/2 WATT	RC20GF220K	81349	745-1282-000
R22	RESISTOR, FXD, FILM 121K OHMS, 1% TOL, 1/2 WATT	RN65D1213F	81349	705-7196-000
R23	RESISTOR, FXD, COMPOSITION 3300 OHMS, 10% TOL, 1/2 WATT	RC20GF332K	81349	745-1373-000
R24	SAME AS R12			
R25	SAME AS R23			
R26	SAME AS R21			
R27	RESISTOR, FXD, FILM 0.27 OHMS, 10% TOL, 3 WATTS	RW69VR27	81349	747-5397-000
R28	RESISTOR, VAR, WIRE WOUND 10K OHMS, 5% TOL, 3/4 WATT	RT22C2P103	81349	381-1721-130
R29	SAME AS R28			
R30	SAME AS R2			
RT1	RESISTOR, THERMAL 10 OHMS, 10% TOL, 1/2 WATT			714-3316-010
T1	TRANSFORMER, AF ENCAPSULATED			667-0198-010
XK1	SOCKET, RELAY 8 TERMINALS			771-9258-001
XK2	SAME AS XK1			
XQ1	SOCKET, TRANSISTOR 4 CONTACTS	22-8	81073	352-9998-000
XQ2	SAME AS XQ1			
XQ3	SOCKET, TRANSISTOR 4 CONTACTS	3303	91662	352-9872-000
XQ4	SAME AS XQ3			
XQ5	SAME AS XQ3			

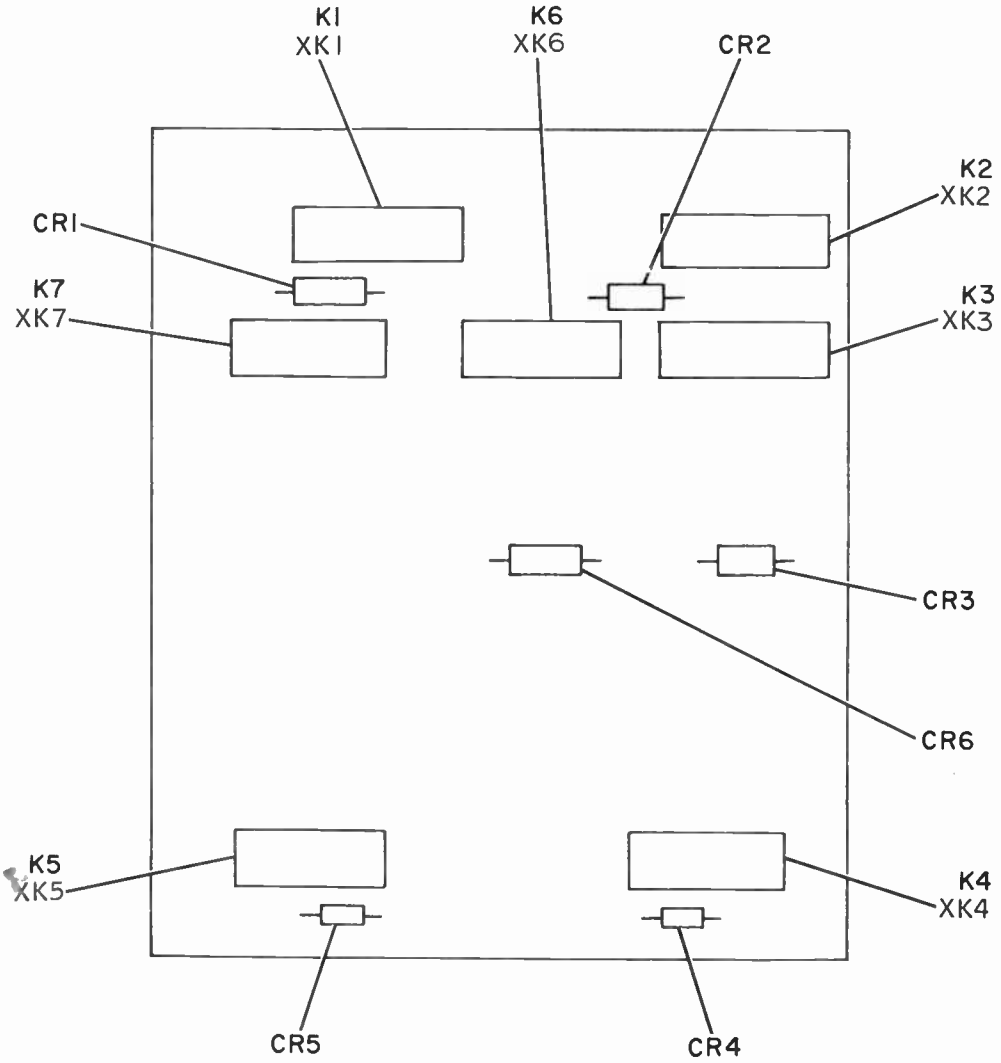


Figure 6-8. Tuning/Power Control Board A7.

SYMBOL	DESCRIPTION	MANUFACTURER'S PART NUMBER	MFR CODE	COLLINS PART NUMBER
	TUNING/POWER CONTROL BOARD A7			771-9070-001
CR1	SEMICONDUCTOR DEVICE, DIODE	1N645	96214	353-2607-000
CR2 THROUGH CR6	SAME AS CR1			
K1	RELAY, ARMATURE 3C CONTACT ARRANGEMENT	93-502333-23300B	80089	970-2454-270
K2 THROUGH K6	SAME AS K1			
K7	RELAY, ARMATURE 2A CONTACT ARRANGEMENT	93-919121-23615B	80089	970-2454-300
XK1	SOCKET, RELAY 8 TERMINALS			771-9243-001
XK2	SAME AS XK1			
XK3	SAME AS XK1			
XK4	SAME AS XK1			
XK5	SOCKET, RELAY 11 TERMINALS			771-9259-001
XK6	SAME AS XK5			
XK7	SAME AS XK1			

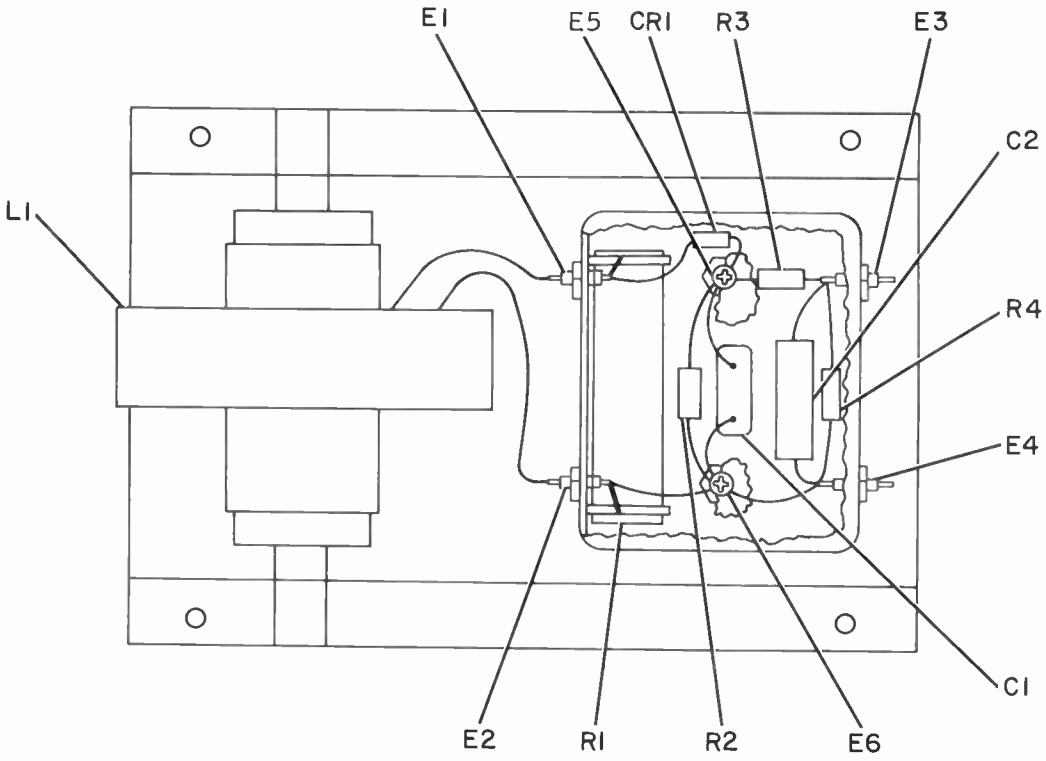


Figure 6-9. Power Control Sensor A8.

SYMBOL	DESCRIPTION	MANUFACTURER'S PART NUMBER	MFR CODE	COLLINS PART NUMBER
	POWER CONTROL SENSOR A8			771-9207-001
C1	CAPACITOR, FXD, MICA 1000 UUF, 5% TOL, 500 VDCW	CM06FD102J03	81349	912-3001-000
C2	CAPACITOR, FXD, ELECTROLYTIC 20 UF, PLUS 75% MINUS 15%, 25 VDCW	29F490G22	06001	184-7233-000
CR1	SEMICONDUCTOR DEVICE, DIODE	1N3064	81349	353-3289-000
E1	TERMINAL, FEEDTHRU	69001-0600	00373	306-1861-000
E2	SAME AS E1			
E3	SAME AS E1			
E4	SAME AS E1			
E5	TERMINAL, STANDOFF	RTMT12P	91663	306-0976-000
E6	SAME AS E5			
L1	COIL, POWER 60 UH			771-9018-001
R1	RESISTOR, FXD, COMPOSITION 22 OHMS, 10% TOL, 15 WATTS	770SP4	10646	712-0011-000
R2	RESISTOR, FXD, COMPOSITION 5600 OHMS, 10% TOL, 1/2 WATT	RC20GF562K	81349	745-1384-000
R3	RESISTOR, FXD, COMPOSITION 22K OHMS, 10% TOL, 1/2 WATT	RC20GF223K	81349	745-1408-000
R4	RESISTOR, FXD, COMPOSITION 39K OHMS, 10% TOL, 1/2 WATT	RC20GF393K	81349	745-1419-000

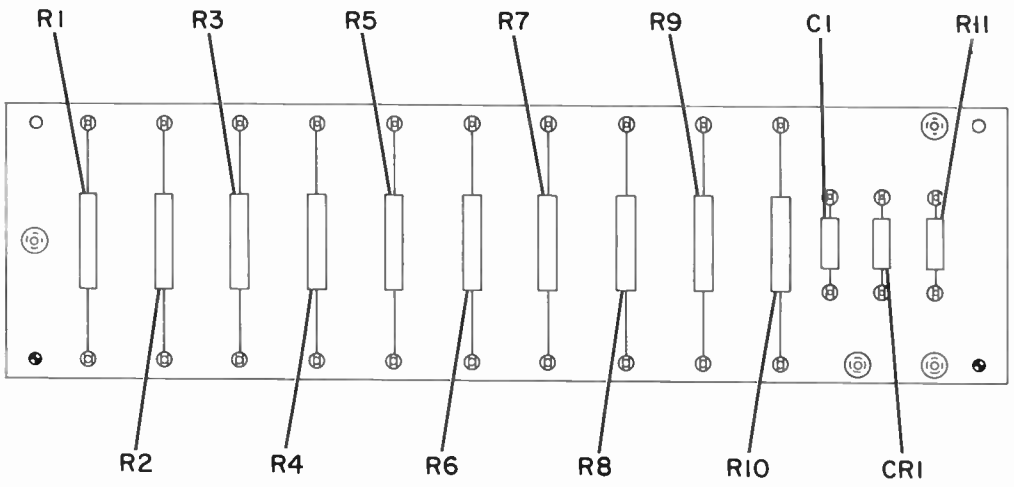


Figure 6-10. Plate Voltage Meter Multiplier A9.

SYMBOL	DESCRIPTION	MANUFACTURER'S PART NUMBER	MFR CODE	COLLINS PART NUMBER
	PLATE VOLTAGE METER MULTIPLIER A9			771-9248-001
C1	CAPACITOR, FXD, CERAMIC 0.1 UF, PLUS 80% MINUS 20%, 200 VDCW	36C190A1	56289	913-3681-000
CR1	SEMICONDUCTOR DEVICE, DIODE	1N976A	04713	353-3236-000
R1	RESISTOR, FXD, FILM 200K OHMS, 1% TOL, 2 WATTS	MEH200K1T1	07716	705-1493-050
R2 THROUGH R10	SAME AS R1			
R11	RESISTOR, FXD, COMPOSITION 10K OHMS, 10% TOL, 2 WATTS	RC42GF103K	81349	745-5694-000

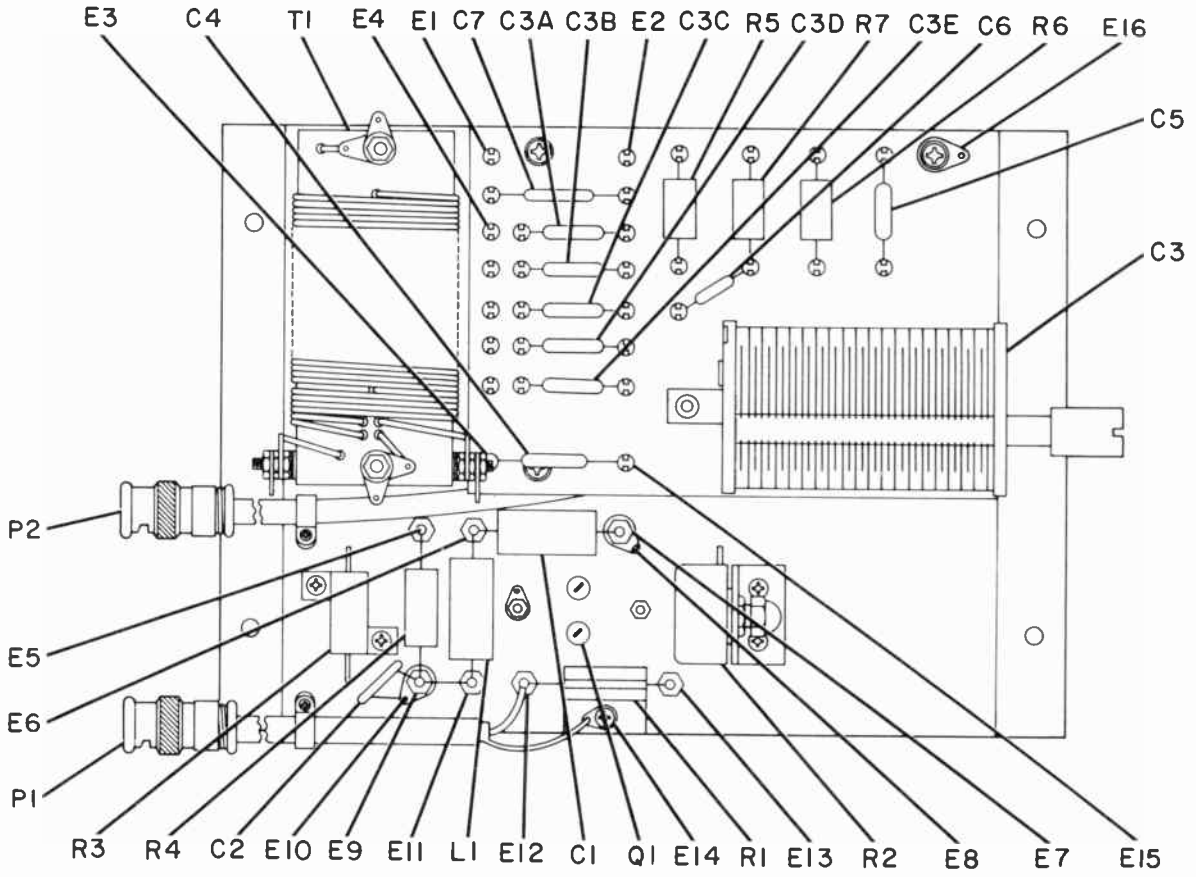


Figure 6-11. RF Driver A11.

SYMBOL	DESCRIPTION	MANUFACTURER'S PART NUMBER	MFR CODE	COLLINS PART NUMBER
	RF DRIVER A11			771-9198-001
C1	CAPACITOR, FXD, FILM 1 UF, 10% TOL, 200 VDCW	74F01BA105	01002	933-1059-050
C2	CAPACITOR, FXD, CERAMIC 0.1 UF, PLUS 80% MINUS 20% 200 VDCW	33C142A1	56289	913-3681-000
C3	CAPACITOR, VAR, AIR 320 UUF MAX-MIN, 13.5 UUF 500 VAC	4112-7	80583	922-1400-000
C3A	CAPACITOR, FXD, MICA 200 UUF, 5% TOL, 1000 VDCW	VDM20-201J1000	72136	912-4143-030
C3B	CAPACITOR, FXD, MICA 390 UUF, 5% TOL, 1000 VDCW	VDM20-391J1000	72136	912-4143-050
C3C	CAPACITOR, FXD, MICA 820 UUF, 5% TOL, 1000 VDCW	VDM20-821J1000	72136	912-4143-010
C3D	CAPACITOR, FXD, MICA 1500 UUF, 5% TOL, 1000 VDCW	VDM20-152J1000	72136	912-4143-170
C3E	SAME AS C3D			
C4	CAPACITOR, FXD, MICA 9100 PF, 1% TOL, 500 VDCW	DM30F912F03	72136	912-3067-000
C5	CAPACITOR, FXD, MICA 5600 PF, 5% TOL, 500 VDCW	CM07FD562J03	81349	912-2717-000
C6	CAPACITOR, FXD, MICA 270 PF, 5% TOL, 500 VDCW	CM05FD271J03	81349	912-2846-000
C7	CAPACITOR, FXD, MICA 10,000 PF, 1% TOL, 500 VDCW	DM30F103F03	72136	912-3068-000
E1	TERMINAL, STUD	1594-3	91833	306-2566-020
E2	SAME AS E1			
E3	SAME AS E1			
E4	SAME AS E1			
E5	TERMINAL, STUD	RTMT12M	91663	306-0976-000
E6	SAME AS E5			
E7	SAME AS E5			
E8	TERMINAL, LUG	2104-04-01-2520N	78189	304-0317-000
E9	SAME AS E5			
E10	SAME AS E8			
E11	SAME AS E5			
E12	SAME AS E5			
E13	SAME AS E5			
E14	SAME AS E8			
E15	SAME AS E1			
E16	SAME AS E8			
L1	CHOKE, RF 150 UH, 20% TOL	37-502	06978	240-0760-000
P1	CONNECTOR, PLUG, COAX	M39012/16-001	81349	357-9292-000
P2	SAME AS P1			
Q1	TRANSISTOR	TA2669	02735	352-0749-010
R1	RESISTOR, FXD, FILM 47 OHMS, 5% TOL, 4 WATTS	HM4705	01121	745-9640-000
R2	RESISTOR, VAR, CERMET 50 OHMS, 20% TOL, 2 WATTS	BK52113	11236	382-0006-010
R3	RESISTOR, FXD, FILM 0.5 OHMS, 1% TOL, 10 WATTS	RE65GR499	81349	747-8587-000
R4	RESISTOR, FXD, COMPOSITION 22 OHMS, 10% TOL, 2 WATTS	RC42GF220K	81349	745-5582-000
R5	RESISTOR, FXD, COMPOSITION 270 OHMS, 5% TOL, 2 WATTS	RC42GF271J	81349	745-5627-000
R6	SAME AS R5			
R7	RESISTOR, FXD, COMPOSITION 18 OHMS, 10% TOL, 2 WATTS	RC42GF180K	81349	745-5579-000
T1	TRANSFORMER, RF			771-9118-001

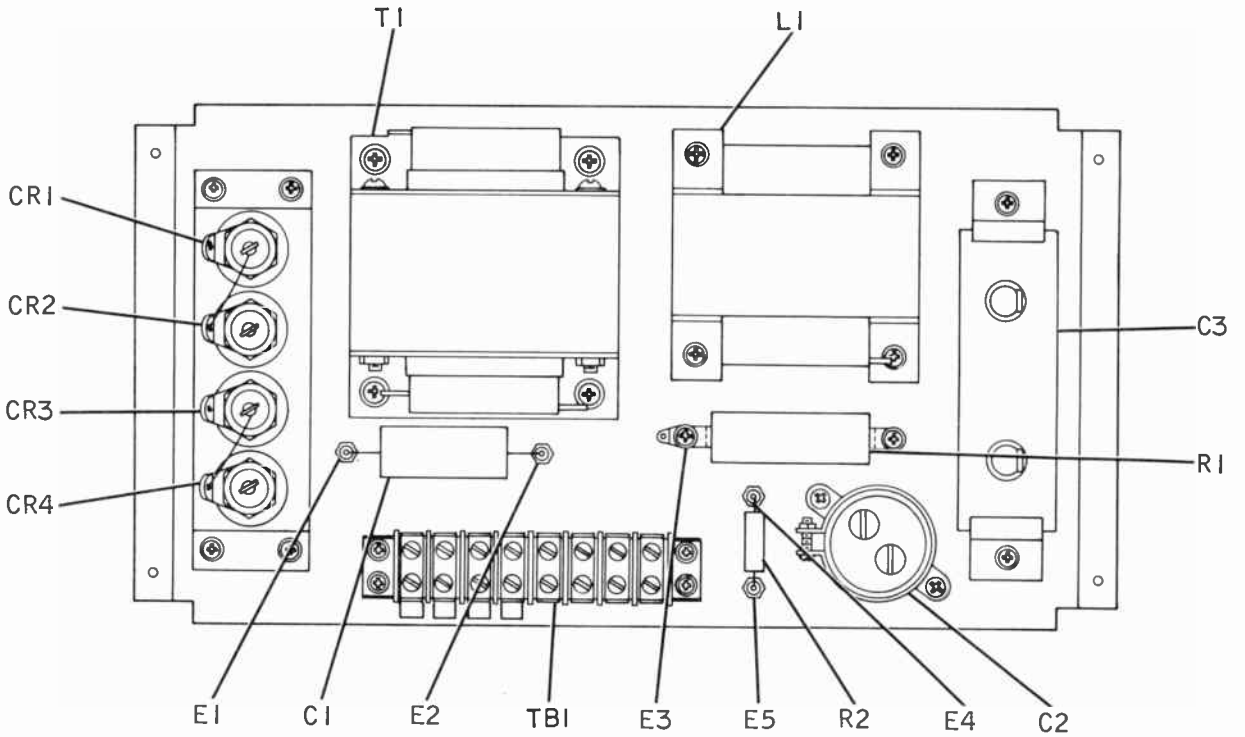


Figure 6-12. 28-Volt Supply A12.

SYMBOL	DESCRIPTION	MANUFACTURER'S PART NUMBER	MFR CODE	COLLINS PART NUMBER
	28V SUPPLY A12			771-9196-001
C1	CAPACITOR, FXD, PAPER 1 UF, 20% TOL, 100 VDCW	196P1050184	56289	931-4500-000
C2	CAPACITOR, FXD, ELECTROLYTIC 1500 UF, PLUS 50% MINUS 10%, 50 VDCW	539-2552-01 MT EP35P-150	53021	183-1297-010
C3	CAPACITOR, FXD, PLASTIC 40 UF, 10% TOL, 50 VDCW	~~LD05-406~~	~~99120~~	~~933-1082-010~~ 933-1088-150
CR1	SEMICONDUCTOR DEVICE, DIODE	1N1184	81349	353-6023-000
CR2	SAME AS CR1			
CR3	SAME AS CR1			
CR4	SAME AS CR1			
E1	TERMINAL, STUD	RTMT12M	91663	306-0976-000
E2	SAME AS E1			
E3	TERMINAL LUG			304-0318-000
E4	SAME AS E1			
E5	SAME AS E1			
L1	FILTER 0.025 H, 3 AMPS			668-0183-010
R1	RESISTOR, FXD, WIRE WOUND 100 OHMS, 5% TOL, 25 WATTS	0200F	44655	710-4761-000
R2	RESISTOR, FXD, FILM 28.7K OHMS, 1% TOL, 3/4 WATT	RN70D2872F	81349	705-7666-000
T1	TRANSFORMER, POWER STEP DOWN, OPEN FRAME	E15524	80008	662-0290-010
TB1	BOARD, TERMINAL 8 TERMINALS	8-141	71785	367-4080-000

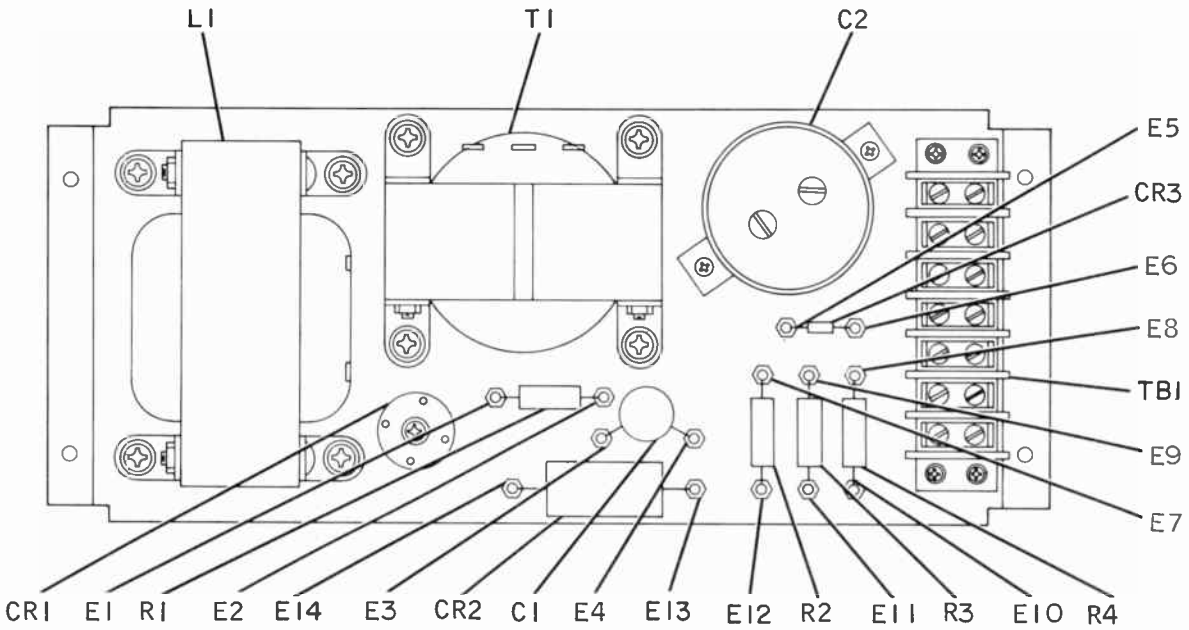


Figure 6-13. Bias Supply A13.

SYMBOL	DESCRIPTION	MANUFACTURER'S PART NUMBER	MFR CODE	COLLINS PART NUMBER
	BIAS SUPPLY A13			771-9206-001
C1	CAPACITOR, FXD, CERAMIC 0.05 UF, PLUS 80% MINUS 20%, 500 VDCW	33C58	01939	913-3153-000
C2	CAPACITOR, FXD, ELECTROLYTIC 750 UF, PLUS 50% MINUS 10%, 200 VDCW	539-2745-01	53021	183-1297-060
CR1	SEMICONDUCTOR DEVICE, DIODE	SCR8	14099	353-0420-060
CR2	SEMICONDUCTOR DEVICE, DIODE	6RS20AP5B2	09214	353-6504-010
CR3	SEMICONDUCTOR DEVICE, DIODE	1N4384	72699	353-6467-020
E1	TERMINAL, STUD	RTMT12M	91663	306-0976-000
E2 THRUGH E14	SAME AS E1			
L1	INDUCTOR 5 H, 175 MA	CT279	14407	668-0157-010
R1	RESISTOR, FXD, COMPOSITION 47 OHMS, 10% TOL, 2 WATTS	RC42GF470K	81349	745-5596-000
R2	RESISTOR, FXD, FILM 75K OHMS, 1% TOL, 3/4 WATT	RN70C7502F	81349	705-7686-000
R3	SAME AS R2			
R4	RESISTOR, FXD, FILM 1.5K OHMS, 1% TOL, 3/4 WATT	RN70D1501F	81349	705-7811-000
T1	TRANSFORMER, POWER 50-60 HZ	P50806	14407	662-0348-010
TB1	BOARD, TERMINAL 7 TERMINALS	7-141	71785	367-4070-000

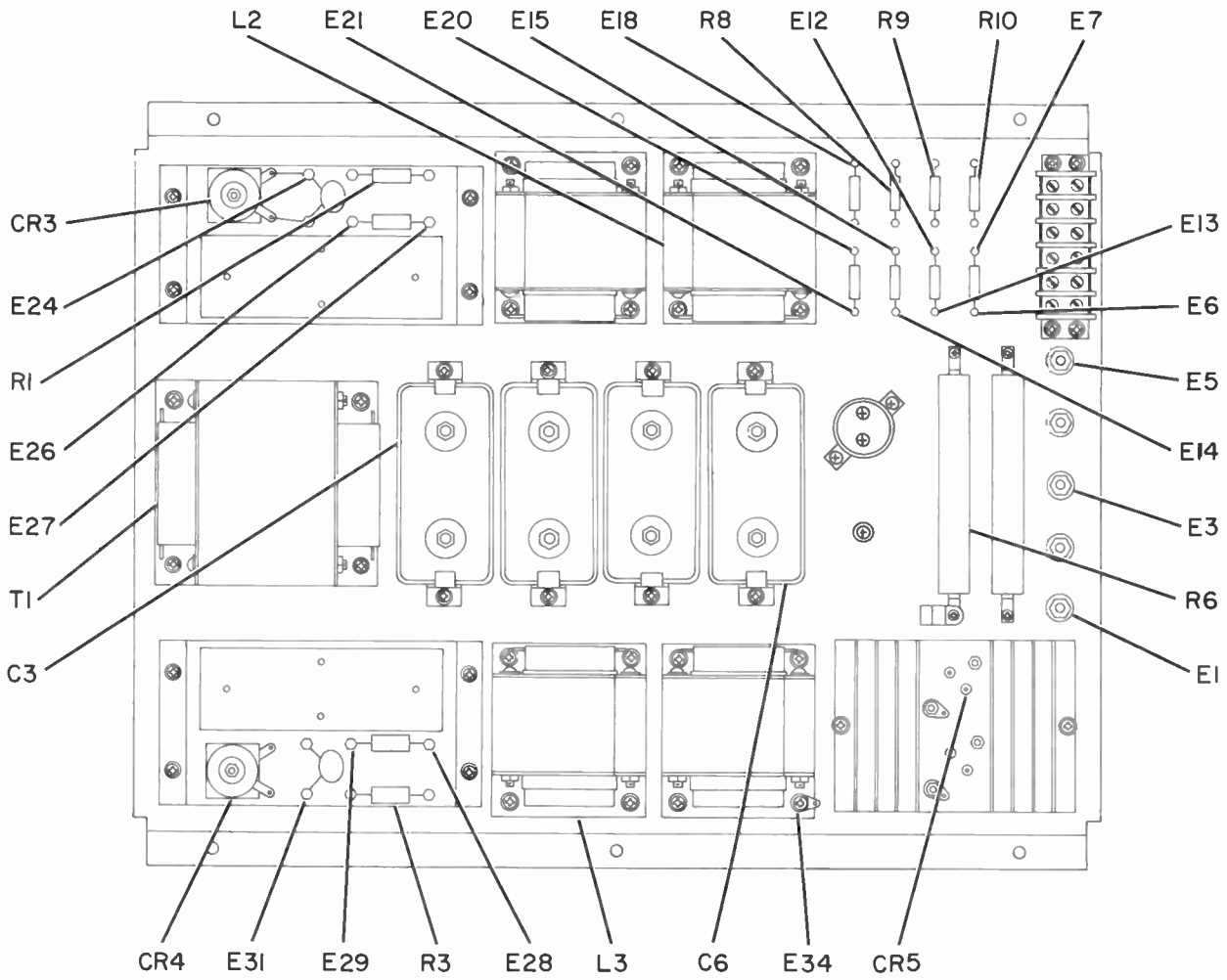


Figure 6-14. Screen Supplies A14 (Sheet 1 of 2).

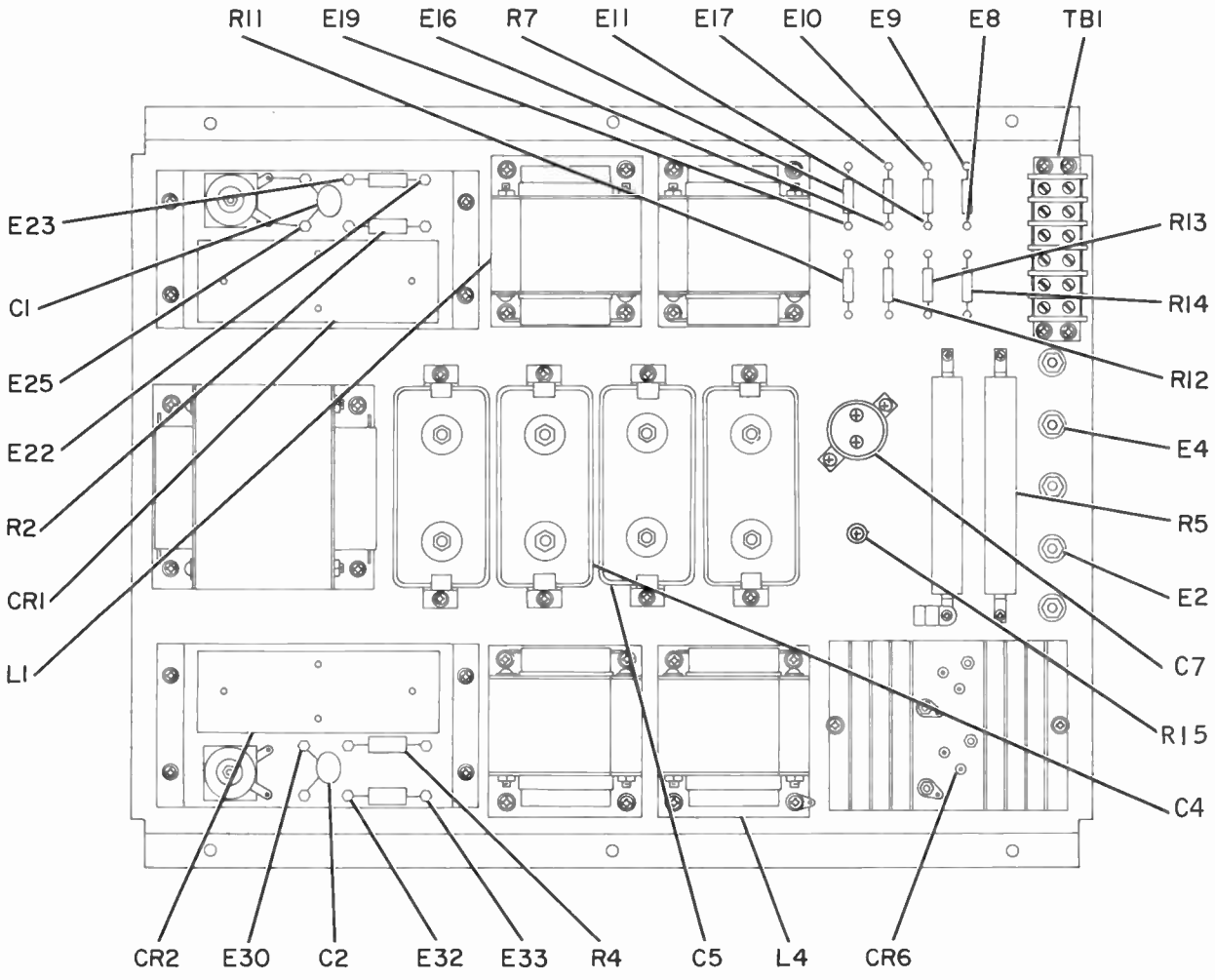


Figure 6-14. Screen Supplies A14 (Sheet 2 of 2).

SYMBOL	DESCRIPTION	MANUFACTURER'S PART NUMBER	MFR CODE	COLLINS PART NUMBER
	SCREEN SUPPLIES \14			771-9165-001
C1	CAPACITOR, FXD, CERAMIC 0.05 UF, PLUS 80% MINUS 20%, 500 VDCW	33658	01939	913-3153-000
C2	SAME AS C1			
C3	CAPACITOR, FXD, PAPER 10 UF, 10% TOL, 1000 VDCW	T10100	09023	930-0038-000
C4	SAME AS C3			
C5	SAME AS C3			
C6	SAME AS C3			
C7	CAPACITOR, FXD, ELECTROLYTIC 200 UF, PLUS 75% MINUS 10%, 350 VDCW	CE71C201P	81349	184-2540-000
CR1	SEMICONDUCTOR DEVICE, DIODE	SPF30	13327	353-3655-020
CR2	SAME AS CR1			
CR3	SEMICONDUCTOR DEVICE, DIODE	6RS21SA15D15	09214	353-0418-010
CR4	SAME AS CR3			
CR5	SEMICONDUCTOR DEVICE, DIODE	1N2844B	04713	353-1447-000
CR6	SEMICONDUCTOR DEVICE, DIODE	1N2842B	04713	353-1443-000
E1	TERMINAL, CERAMIC	NS5W0208	70371	190-0018-000
E2 THROUGH E5	SAME AS E1			
E6	TERMINAL, STUD	RTMT12M	91663	306-0976-000
E7 THROUGH E33	SAME AS E6			
E34	TERMINAL, LUG	2104-06-02-2520N	78189	304-0318-000
L1	REACTOR, FILTER 8 H, 200 MA	E15573	80008	668-0155-010
L2	SAME AS L1			
L3	SAME AS L1			
L4	SAME AS L1			
R1	RESISTOR, FXD, COMPOSITION 180 OHMS, 10% TOL, 2 WATTS	RC42GF181K	81349	745-5621-000
R2	SAME AS R1			
R3	SAME AS R1			
R4	SAME AS R1			
R5	RESISTOR, FXD, WIRE WOUND 25K OHMS, 5% TOL, 50 WATTS			710-9354-000
R6	RESISTOR, FXD, WIRE WOUND 12K OHMS, 5% TOL, 50 WATTS	0415	44655	710-3381-000
R7	RESISTOR, FXD, FILM 249K OHMS, 1% TOL, 500 WATTS	RN70D2493F	81349	705-7711-000
R8	SAME AS R7			
R9	SAME AS R7			
R10	RESISTOR, FXD, FILM 1.5K OHMS, 1% TOL, 500 WATTS	RN70D1501F	81349	705-7811-000
R11	SAME AS R7			
R12	SAME AS R7			
R13	SAME AS R7			
R14	SAME AS R10			
R15	RESISTOR, FXD, WIRE WOUND 25K OHMS, 5% TOL, 10 WATTS	1-3-4D57F25000	44655	710-2918-000
T1	TRANSFORMER, POWER, STEP-UP 50-60 HZ	E15572	80008	662-0316-010
TB1	STRIP, TERMINAL 6 TERMINALS	6-141	71785	367-4060-000

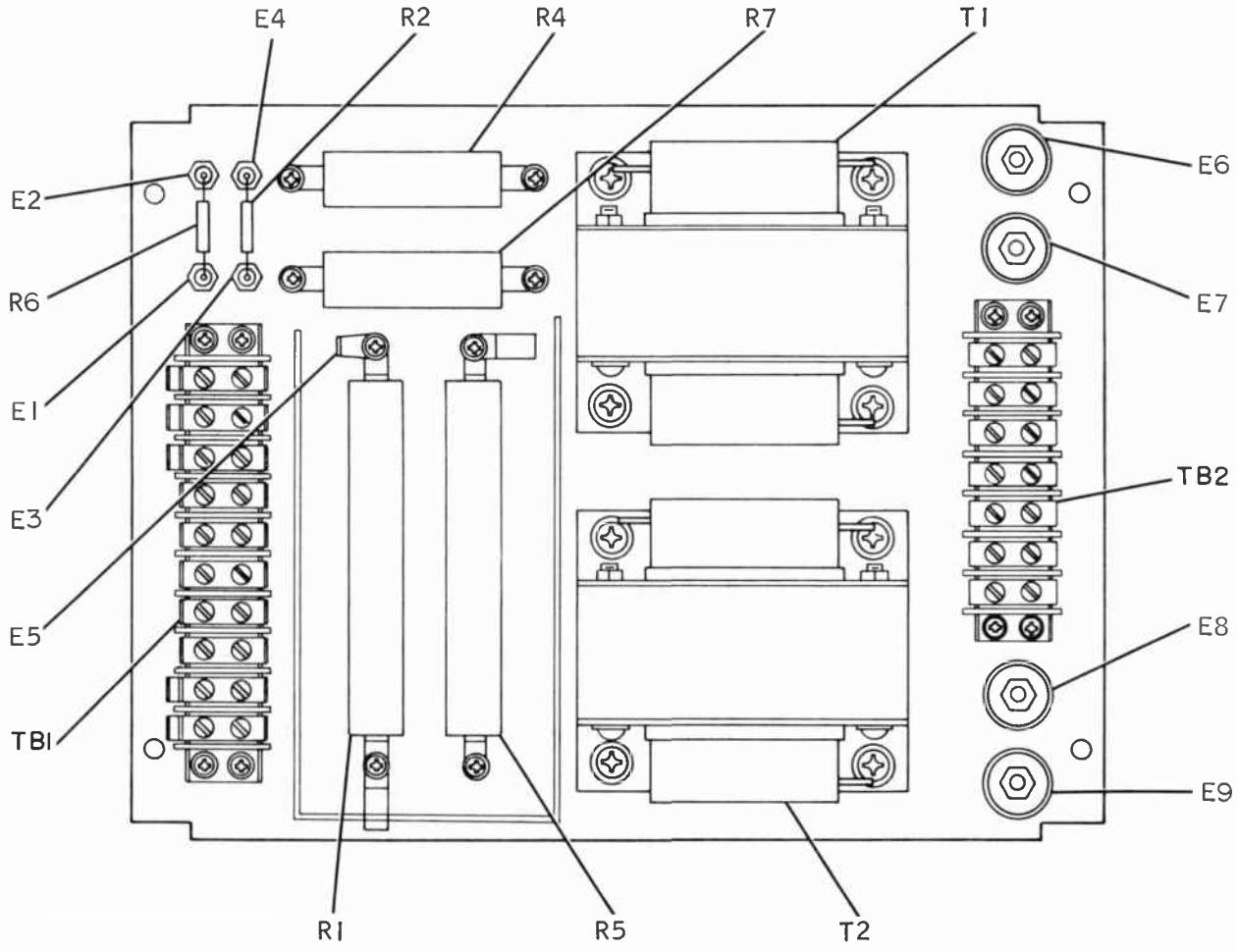


Figure 6-15. Filament/Cathode Circuits A15.

SYMBOL	DESCRIPTION	MANUFACTURER'S PART NUMBER	MFR CODE	COLLINS PART NUMBER
	FILAMENT/CATHODE CIRCUITS A15			771-9194-001
E1	TERMINAL, STUD	RTMT12M	91663	306-0976-000
E2	SAME AS E1			
E3	SAME AS E1			
E4	SAME AS E1			
E5	TERMINAL, LUG	2104-06-02-2520N	78189	304-0318-000
E6	STANDOFF, CERAMIC	E1015	70371	190-1161-000
E7	SAME AS E6			
E8	SAME AS E6			
E9	SAME AS E6			
R1	RESISTOR, FXD, WIRE WOUND 2.5K OHMS, 5% TOL, 50 WATTS	0408	44655	710-3374-000
R2	RESISTOR, FXD, WIRE WOUND 5 OHMS, 1% TOL, 2.5 WATTS	8845 5J	44655	746-9441-000
R3	NOT USED			
R4	RESISTOR, FXD, WIRE WOUND 1 OHM, 1% TOL, 3W WATTS	2K46C1	44655	710-5076-010
R5	RESISTOR, FXD, WIRE WOUND 10 OHMS, 5% TOL, 50 WATTS	0400B	44655	710-3355-000
R6	SAME AS R2			
R7	SAME AS R4			
T1	TRANSFORMER, FILAMENT OPEN FRAME			662-0361-010
T2	SAME AS T1			
TB1	BOARD, TERMINAL 10 TERMINALS	10-141	71785	367-4100-000
TB2	BOARD, TERMINAL 7 TERMINALS	7-141	71785	367-4070-000

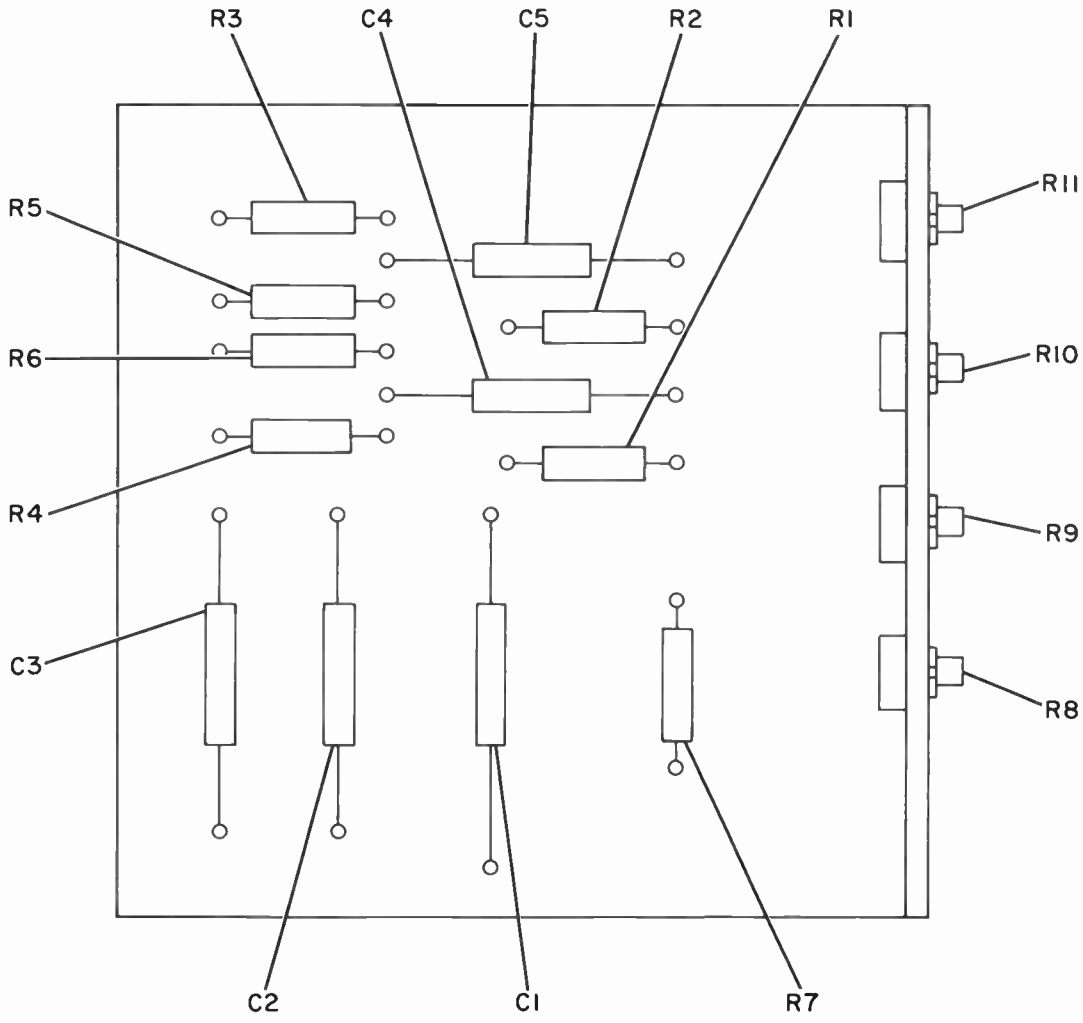


Figure 6-16. Modulator Control A16.

SYMBOL	DESCRIPTION	MANUFACTURER'S PART NUMBER	MFR CODE	COLLINS PART NUMBER
	MODULATOR CONTROL A16			771-9277-001
C1	CAPACITOR, FXD, PAPER 2.0 UF, 20% TOL, 600 VDCW	118P20506S4	56289	951-1071-000
C2	CAPACITOR, FXD, PAPER 3.0 UF, 20% TOL, 200 VDCW	118P30502S4	56289	951-1045-000
C3	SAME AS C2			
C4	CAPACITOR, FXD, PAPER 0.33 UF, 20% TOL, 600 VDCW	118P33406S4	56289	951-1066-000
C5	SAME AS C4			
R1	RESISTOR, FXD, COMPOSITION 15K OHMS, 10% TOL, 2 WATTS	RC42GF153K	81349	745-5701-000
R2	SAME AS R1			
R3	RESISTOR, FXD, COMPOSITION 47 OHMS, 10% TOL, 2 WATTS	RC42GF470K	81349	745-5596-000
R4	RESISTOR, FXD, COMPOSITION 100K OHMS, 10% TOL, 2 WATTS	RC42GF104K	81349	745-5736-000
R5	SAME AS R4			
R6	SAME AS R3			
R7	RESISTOR, FXD, COMPOSITION 2700 OHMS, 10% TOL, 2 WATTS	RC42GF272K	81349	745-5670-000
R8	RESISTOR, VAR, COMPOSITION 10K OHMS, 10% TOL, 2 WATTS	RV4LAXSA103A	81349	380-5782-000
R9	SAME AS R8			
R10	RESISTOR, VAR, COMPOSITION 5K OHMS, 10% TOL, 2 WATTS	RV4LAXSA502A	81349	380-5793-000
R11	SAME AS R10			

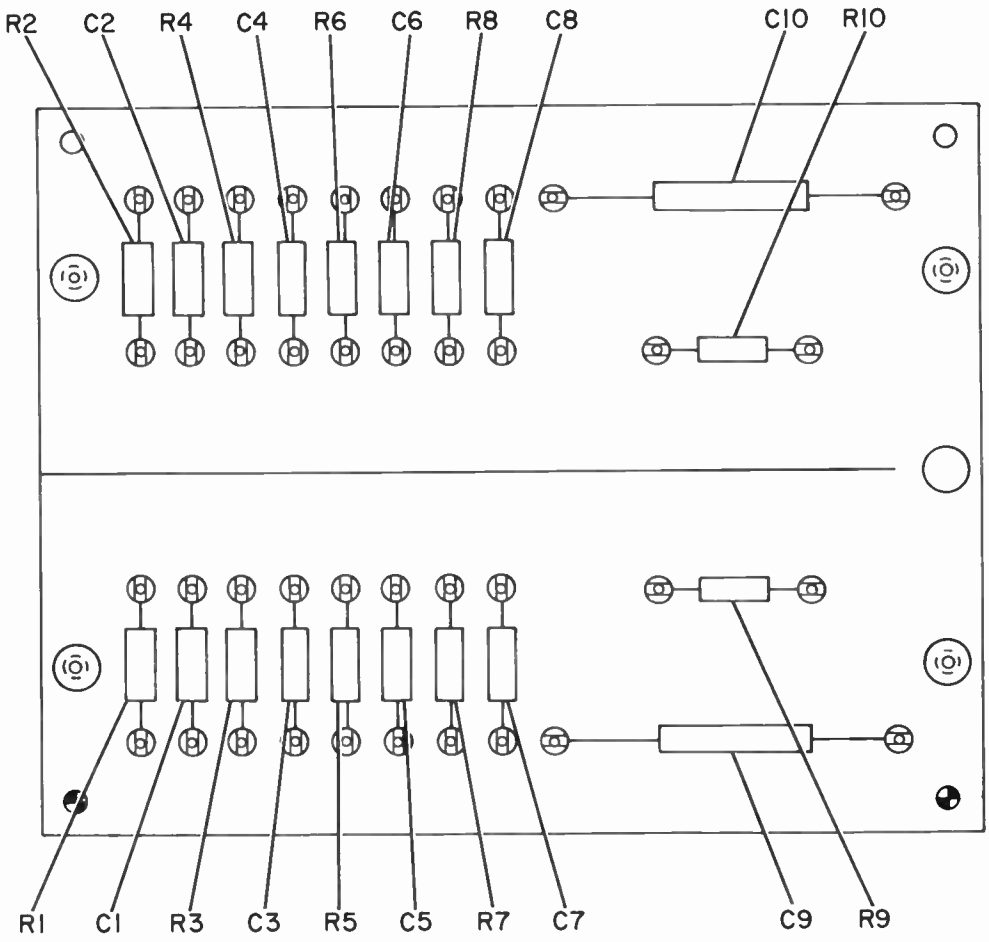


Figure 6-17. Modulator Feedback Divider A17.

SYMBOL	DESCRIPTION	MANUFACTURER'S PART NUMBER	MFR CODE	COLLINS PART NUMBER
	MODULATOR FEEDBACK DIVIDER A17			771-9254-001
C1	CAPACITOR, FXD, MICA 100 UUF, 5% TOL, 500 VDCW	DM10F101-1CR	72136	912-4907-000
C2 THROUGH C8	SAME AS C1			
C9	CAPACITOR, FXD, PAPER 1 UF, 20% TOL, 200 VDCW	118P10502S4	56289	951-1042-000
C10	SAME AS C9			
R1	RESISTOR, FXD, COMPOSITION 820K OHMS, 5% TOL, 2 WATTS	RC42GF824J	81349	745-5774-000
R2 THROUGH R10	SAME AS R1			

SYMBOL	DESCRIPTION	MANUFACTURER'S PART NUMBER	MFR CODE	COLLINS PART NUMBER
	MANUFACTURERS CODES			
CODE	MANUFACTURER			
00373	GARLOCK INC. ELECTRONIC PRODUCTS DIVISION 8 FELLOWSHIP ROAD CHERRY HILL, N.J. 08034			
00853	SANGAMO ELECTRIC CO. S. CAROLINA DIVISION PICKENS, S.C.			
01002	GENERAL ELECTRIC CO. CAPACITOR DEPT. JOHN ST. HUDSON FALLS, N.Y. 12839			
01939	SPRAGUE ELECTRIC CO. OF WISCONSIN GRAFTON, WIS.			
02735	RADIO CORP. OF AMERICA SOLID STATE AND RECEIVING TUBE DIVISION ROUTE 202 SOMERVILLE, N.J. 08876			
03508	GENERAL ELECTRIC CO. SEMI-CONDUCTOR PRODUCTS DEPT ELECTRONICS PARK SYRACUSE, N.Y. 13201			
04713	MOTOROLA SEMICONDUCTOR PRODUCTS INC. 5005 EAST MCDOWELL ROAD PHOENIX, ARIZ. 85008			
06001	GENERAL ELECTRIC CO. CAPACITOR DEPT. P.O. BOX 158 IRMO, S.C. 29063			
06378	ALADDIN ELECTRONICS DIVISION OF ALADDIN INDUSTRIES INC. 705 MURFREESBORO ROAD NASHVILLE, TENN. 37210			
07716	I.R.C. INC. 2850 MT. PLEASENT BURLINGTON, IOWA 52601			
07886	NATIONAL RADIO CO. INC. 37 WASHINGTON ST. MELROSE, MASS. 02176			
09023	CORNELL-DUBILIER ELECTRIC CORP. ELECTROLYTICS AND PAPER TUBULAR DIVISION 2562 DALRYMPLE SANFORD, N.C.			
09214	GENERAL ELECTRIC CO. SEMI-CONDUCTOR PRODUCTS DEPT WEST GENESEE ST. AUBURN, N.Y. 31022			
10646	CARBORUNDUM CO. P.O. BOX 337 NIAGARA FALLS, N.Y. 14302			
11236	CTS OF BERNE INC. 406 PARR ROAD BERNE, IND. 46711			
11700	J.B. ELECTRONIC TRANSFORMERS INC. 2310 W. ARMITAGE CHICAGO, ILL. 60647			
13327	SOLITRON DEVICES INC. 256 OAK TREE ROAD TAPPAN, N.Y. 10983			

SYMBOL	DESCRIPTION	MANUFACTURER'S PART NUMBER	MFR CODE	COLLINS PART NUMBER
14C99	SEMTECH CORP. 652 MITCHELL ROAD NEWBURY PARK, CALIF. 91320			
14407	TEXAS TRANSFORMER ENGINEERING AND MFG. CO. 1404 J. AVE. PLANO, TEXAS 75074			
17771	SINGER CO. DIEHL DIVISION FINDERNE PLANT FINDERNE AVE. SOMERVILLE, N.J. 08876			
21537	SCREW CRAFT PRODUCTS 1912 N. ELSTON AVE. CHICAGO, ILL.			
44655	OHMITE MFG. CO. 3601 W. HOWARD ST. SKOKIE, ILL. 60076			
52090	ROWAN CONTROLLER CO. P.O. BOX 306 WESTMINSTER, MD. 21157			
53021	SANGAMO ELECTRIC CO. 1301 N. 11TH. SPRINGFIELD, ILL. 62705			
55814	SOLA ELECTRIC CO. ELK GROVE, ILL.			
56289	SPRAGUE ELECTRIC CO. MARSHALL ST. NORTH ADAMS, MASS. 01247			
65092	WESTON INSTRUMENTS INC. 614 FRELINGHUYSEN AVE. NEWARK, N.J. 07114			
70471	AMERICAN LAVA CORP. 210 KRUESI BLDG. CHATTANOOGA, TENN.			
71400	BUSSMANN MFG. DIVISION OF MCGRAW-EDISON CO. 2536 W. UNIVERSITY ST. ST. LOUIS, MO. 63017			
71482	CLARE, C.P. AND CO. 3118 W. DEVON AVE. CHICAGO, ILL. 60645			
71590	CENTRALAB DIVISION OF GLOBE-UNION INC. 932 E. KEEFE AVE. MILWAUKEE, WIS. 53212			
71785	CINCH MFG. CO. AND HOWARD B. JONES DIVISION 1026 S. HOMAN AVE. CHICAGO, ILL. 60624			
72136	ELECTRIC MOTIVE MFG. CO. SOUTH PARK AND JOHN ST. WILLIMATIC, CONN. 06226			
72699	GENERAL INSTRUMENT CORP. 65 GOUVERNEUR ST. ST. NEWARK, N.J. 07104			
72982	ERIE TECHNOLOGICAL PRODUCTS 644 W. 12TH. ST. ERIE, PA. 16512			
73905	JENNINGS RADIO MFG. CORP. 970 MCLAUGHLIN AVE. SAN JOSE, CALIF. 95108			
74970	JOHNSON, E.F. CO. 297 TENTH AVE. S.W. WASECA, MINN. 56093			
75173	JONES, HOWARD B. DIVISION OF CINCH MFG. CO. CHICAGO. ILL.			
76854	OAK MFG. CO. S. MAIN CRYSTAL LAKE, ILL. 60014			
77147	PATTON MACGUYER CO.			

SYMBOL	DESCRIPTION	MANUFACTURER'S PART NUMBER	MFR CODE	COLLINS PART NUMBER
	EDGEWOOD STATION PROVIDENCE, R.I. 02905			
77250	PHEOLL MFG. CO. CHICAGO, ILL.			
77342	AMERICAN MACHINE AND FOUNDRY CO. POTTER AND BRUMFIELD DIVISION RD. 64 E. PRINCETON, IND. 47570			
78189	SHAKEPROOF DIVISION OF ILLINOIS TOOL WORKS INC. ST. CHARLES ROAD ELGIN, ILL. 60120			
80008	ELECTRO ENGINEERING WORKS A DIVISION OF THE RUCKER CO. 401 PREDA ST. SAN LEANDRO, CALIF. 94577			
80058	JOINT ELECTRONIC TYPE DESIGNATION SYSTEM			
80089	ESSEX WIRE CORP. CONTROLS DIVISION 131 GODFREY ST. LOGANSPORT, IND. 46947			
80223	UNITED TRANSFORMER CO. 150 VARICK ST. NEW YORK, N.Y. 10013			
80483	ALADDIN INDUSTRIES INC. 705 MURFREESBORO RD. NASHVILLE, TENN. 37210			
80583	HAMMARLUND CO. INC. 73-88 HAMMARLUND DRIVE MARS HILL, N.C. 28754			
81073	GRAYHILL INC. 561 HILLGROVE AVE. LA GRANGE, ILL. 60525			
81349	MILITARY SPECIFICATIONS			
81416	ELECTRAN MFG. CO. 1901 CLYBOURN AVE. CHICAGO, ILL. 60614			
82219	SYLVANIA ELECTRIC PRODUCTS INC. ELECTRONIC TUBE DIVISION RECEIVING TUBE OPERATIONS EMPORIUM, PA.			
82647	METALS AND CONTROLS INC. CONTROL PRODUCTS GROUP 34 FOREST ST. ATTLEBORO, MASS. 02703			
82877	ROTRON MFG. CO. INC. 7-9 HASBROUCK LANE WOODSTOCK, N.Y. 12498			
91662	ELCO CORP. MARYLAND ROAD AND COMPUTER AVE. WILLOW GROVE, PA. 19090			
91663	ARMEL ELECTRONICS INC. 1601 75TH STREET NORTH BERGEN, N.J. 07047			
91833	KEYSTONE ELECTRONICS CORP. 49 BLEECKER ST. NEW YORK, N.Y. 10012			
91929	HONEYWELL INC. MICRO SWITCH DIVISION CHICAGO AND SPRING STREETS FREEPORT, ILL. 61032			
96182	MASTER SPECIALTIES CO. 1640 MONROVIA COSTA MESA, CALIF. 92627			
96214	TEXAS INSTRUMENTS INC.			

SYMBOL	DESCRIPTION	MANUFACTURER'S PART NUMBER	MFR CODE	COLLINS PART NUMBER
	APPARATUS DIVISION 6000 LEMMON AVE. DALLAS, TEXAS 75209			
96906	MILITARY STANDARDS			
97965	ESSEX WIRE CORP. ELECTRONIC MARKETING DIVISION CHICAGO, ILL.			
99120	PLASTIC CAPACITORS INC. 2620 N. CLYBOURN AVE. CHICAGO, ILL. 60614			
99800	DELEVAN ELECTRONICS CORP. 270 QUAKER RD. EAST AURORA, N.Y. 14052			
99942	GLOBE-UNION INC. CENTRALAB SEMICONDUCTOR 4501 N. ARDEN DR. EL MONTE, CALIF. 91734			

312-489-2229

310W-1

AM Broadcast Exciter

COLLINS

unit instructions

Collins Radio Company | Dallas, Texas

Second Printing March 1968
Printed in United States of America

523-0556833-101438
1 March 1968

1. GENERAL DESCRIPTION

1.1 Purpose of Unit

The 310W-1 AM Broadcast Exciter (figure 1) is the frequency-determining unit for a transmitter operating in the 540- to 1600-kHz AM broadcast band.

1.2 Unit Description

The 310W-1 is built on a 6- by 8- by 3-1/2-inch chassis attached to a mounting panel rack. A 2-position rotary switch, mounted on the front panel, selects the desired operating crystals. Each crystal oscillator frequency is adjusted by a screwdriver control on the front panel. Rf output is obtained from a BNC connector on the rear of the chassis. Operating voltage, 28 volts dc, is connected to terminals on the rear of the chassis from an external power supply.

2. UNIT CHARACTERISTICS

2.1 Physical Characteristics

Size:
  Front Panel
    3-1/2 by 19 inches
    3-1/2 by 13-1/2 inches

  Chassis Behind Front Panel
    6 by 8 inches

Type of Mounting:
  3-1/2- by 19-inch panel or 3-1/2 by 13-1/2-inch panel (no additional support required)

Weight:
  3-1/2 pounds, approximate

Finish:
  19-Inch Front Panel Options
    White (standard)
    Gray (on special order)

  13-1/2-Inch Front Panel Options
    Gray (standard)
    White (on special order)

  Unpainted Surfaces
    Clear chromate

Ventilation:
  None required

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Figure 1. 310W-1 AM Broadcast Exciter.

2.2 Operating Characteristics

Ambient Service Conditions:
Temperature
-25° to +45°C (-13° to +113°F)

Relative Humidity
Up to 95%

Altitude
Up to 10,000 feet above msl

Type of Service:
Continuous

2.3 Electrical Characteristics

Power Requirements:
28 ±2.8 volts dc, 0.3 ampere

Output Level (Across a 50-Ohm Resistive Load):
2 watts, 24 volts peak-to-peak, non-sinusoidal

Output Impedance:
50 ohms nominal, unbalanced

Output Frequency Range:
540 to 1600 kHz

Range of Crystal Frequencies:
2160 to 4320 kHz

Output Frequency Stability:
±5 Hz from 0° to +35°C (+32° to +95°F)
±10 Hz from -10° to +45°C
(+14° to +113°F)
±20 Hz from -25° to +45°C
(-13° to +113°F)

RF Output:
Continuous wave, nonsinusoidal

Front Panel Controls:
CRYSTAL SELECTOR
Switch (selects the operating crystal)
Trimmer (adjusts output frequency)

3. CIRCUIT DESCRIPTION

Frequency generation at 2 or 4 times the carrier frequency is used to capitalize on the frequency range in which the quartz crystals are inherently more stable. Division by 4, using two astable multivibrator integrated circuits, provides an output frequency between 540 and 1080 kHz. Division by 2, using one integrated circuit, provides output frequencies above 1080 kHz.

Transistor Q1 and associated components form a Pierce oscillator (figure 3). CRYSTAL SELECTOR switch S1 selects one of two crystals, Y1 or Y2, for use in the oscillator tank circuit. The output of the oscillator is RC coupled from the emitter of Q1 to the frequency-divider driver circuits, consisting of transistors Q2 and Q3. The output of the driver circuit, taken from the collector of transistor Q3, is coupled through capacitor C14 to the input of the frequency-divider circuit. Diode CR4 clamps the negative-going peaks of the driver input to a positive level determined by zener diode CR3. This protects the frequency-divider circuit from an excessive signal. The frequency-divider circuit, composed of astable multivibrator integrated circuits Z1 and Z2, divides the input frequency by 2 or 4, depending upon the circuit configuration. The configuration shown in the schematic diagram divides by 4. The outputs of the frequency divider, taken from pins 5 and 6 of Z1, are applied to a push-pull amplifier, consisting of transistors Q4 and Q5. From Q4 and Q5 the signal is coupled to a second push-pull amplifier, consisting of transistors Q6 and Q7. From Q6 and Q7 the signal is applied to transformer T1. Transformer T1 combines the outputs from Q6 and Q7 and applies the resultant signal to the 310W-1 load. When the load is resistive, the output is a square wave; however, when the load is an rf driver tuned circuit, the output is essentially a sine wave.

4. MAINTENANCE

4.1 Recommended Test Equipment

The following test equipment, or equivalent, is recommended for maintenance of the 310W-1.

Oscilloscope, Tektronix 545B with type-H plug-in unit

Multimeter, Triplett 630-NA

4.2 Minimum Performance Test Procedures

4.2.1 General

Perform the procedures of paragraphs 4.2.2 and 4.2.3 after repairing the 310W-1. Before starting the procedures, check that the correct crystal is being used. (Refer to paragraph 4.2.2, steps b. and c.)

4.2.2 Initial Test Setup

a. Remove the top cover from the 310W-1.
b. Check the following items if the output frequency is between 540 and 1080 kHz.
   1. Ensure that the tabs on integrated circuits Z1 and Z2 are aligned with the black marks on the chassis.
   2. Multiply the exciter output frequency by 4 and check that the result matches the crystal frequency.
c. Check the following items if the output frequency is above 1080 kHz.
   1. Ensure that the tab on integrated circuit Z1 is aligned with the black mark on the chassis.
   2. Note that Z2 is removed and a jumper is connected between E1 and E2.
   3. Multiply the exciter output frequency by 2 and check that the result matches the crystal frequency.
d. Remove crystals Y1 and Y2.
e. Connect rf cable W12 to 50 OHM OUTPUT connector J1 on the back of the 310W-1.
f. Connect the other end of W12 to transmitter-driver input jack. Ensure that the transmitter is turned off.

Note

If the transmitter cannot be used, the 310W-1 must be connected to a 50-ohm resistive load.

g. Connect an oscilloscope to the grid of the first driver tube in the transmitter. (If the transmitter is not used, connect the oscilloscope to the resistive load.)
h. Connect the power supply to the +28VDC terminals on the 310W-1. Connect a multimeter (ampere scale) in series with the positive lead of the power supply.

4.2.3 Test Procedure

a. Note that no signal is displayed on the oscilloscope.
b. Read the indication on the multimeter. It should be not more than 0.095 ampere.
c. Disconnect the power supply lead from the +28VDC terminal.
d. Install crystal Y1.
e. Set CRYSTAL SELECTOR switch S1 to 1.
f. Reconnect the multimeter to the +28VDC terminal.
g. Note the signal displayed on the oscilloscope. The signal measured should be a sine wave of not less than 180 volts peak-to-peak. (It should be not less than 24 volts peak-to-peak for a 50-ohm resistive load.)
h. Read the indication on the multimeter. It should be not more than 0.3 ampere.
i. Set CRYSTAL SELECTOR switch S1 to 2. Note that the signal displayed on the oscilloscope drops to zero.
j. Disconnect the multimeter from the positive lead of the power supply.
k. Install crystal Y2 and remove crystal Y1.
l. Reconnect the multimeter to the positive lead of the power supply.
m. Note the signal displayed on the oscilloscope. It should be the same as that observed in step g.
n. Set CRYSTAL SELECTOR switch S1 to 1. Note that the signal displayed on the oscilloscope drops to zero.
o. Install crystal Y1.
p. Replace the top cover.

4.3 Troubleshooting

The following procedures are recommended for troubleshooting the 310W-1.

a. Visually inspect the unit for loose connections and signs of component damage.
b. Make voltage measurements at the emitter, base, and collector of each transistor with 28 volts applied to the +28VDC terminals. Refer to table 1 for the nominal voltages that should be present.

Caution

Ensure that all power is removed from the 310W-1 before making resistance and continuity measurements.

c. Make resistance and continuity measurements, using the schematic diagram (figure 3) as a guide.
d. Refer to the parts list (paragraph 5) for the correct defective component replacement.

4.4 Replacement and Spare Parts

Replacement and spare parts may be ordered from the following address:

Collins Radio Company
Service Parts, 412-024
1225 North Alma Road
Richardson, Texas 75080

Table 1. Voltage Measurements.

COMPONENT	*TEST POINT	VOLTS DC (nominal)	VOLTS AC (nominal) (rms)	COMPONENT	*TEST POINT	VOLTS DC (nominal)	VOLTS AC (nominal) (rms)
Q1	Emitter	2.2	310 mv	Q6	Emitter	2.2	-
	Base	2.3	0		Base	1.2	-
	Collector	11.5	600 mv		Collector	26.0	-
Q2	Emitter	21.0	120 mv	Q7	Emitter	2.2	-
	Base	22.0	240 mv		Base	1.4	-
	Collector	23.5	1.3		Collector	26.0	-
Q3	Emitter	13.2	300 mv	**Z1	Pin 1	19.0	-
	Base	12.7	1.3		Pin 2	19.0	-
	Collector	18.0	1.0		Pin 3	18.0	-
Q4	Emitter	19.0	-		Pin 4	18.0	-
	Base	19.5	-		Pin 5	19.0	-
	Collector	5.4	-		Pin 6	19.5	-
Q5	Emitter	19.0	-		Pin 7	18.0	-
	Base	19.0	-		Pin 8	26.0	-
	Collector	5.9	-				

*All measurements are made from test point to chassis ground.
**If Z2 is used, the voltage measurements are the same as for Z1.

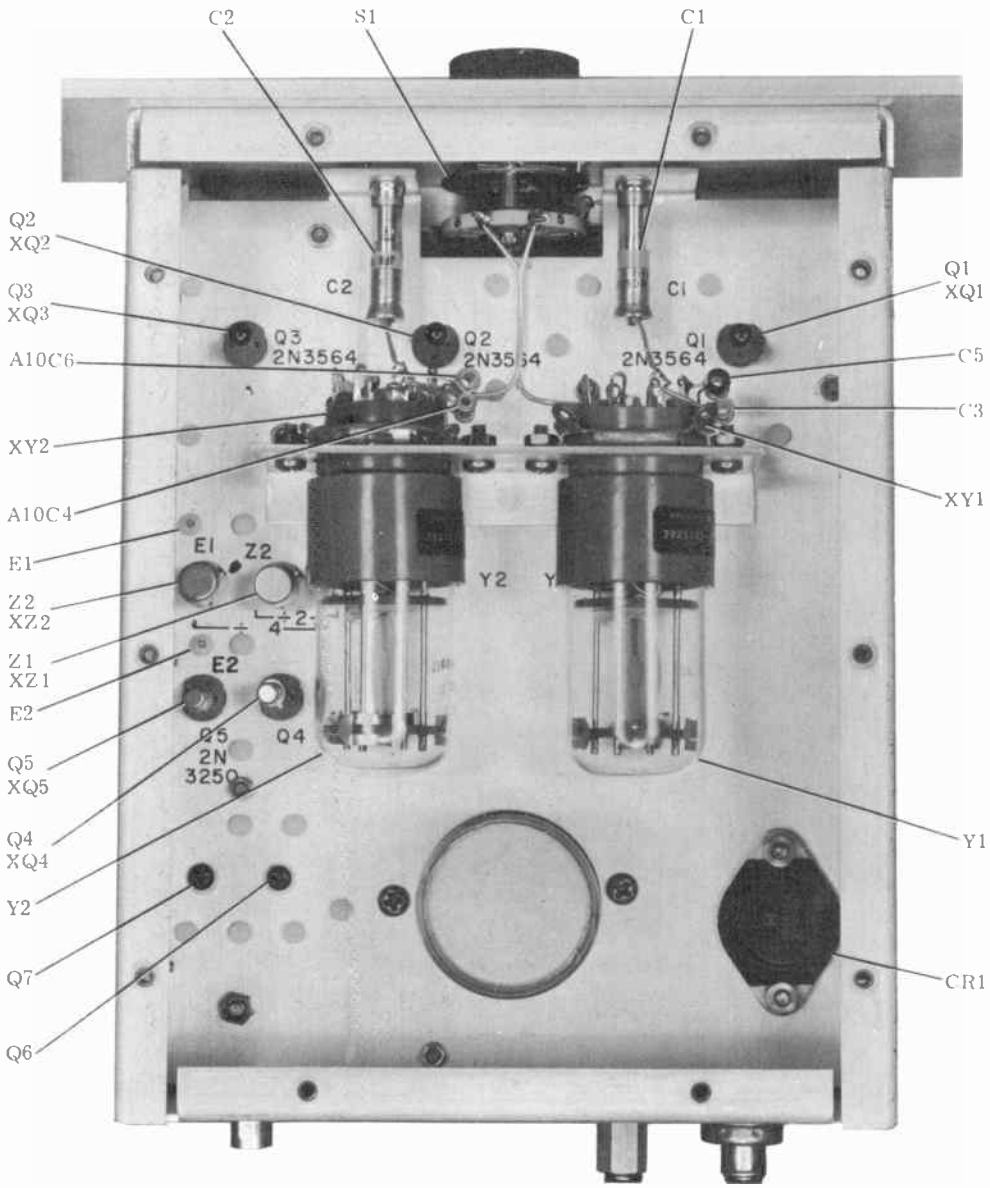

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Figure 2. 310W-1 AM Broadcast Exciter, Parts Identification (Sheet 1 of 2).

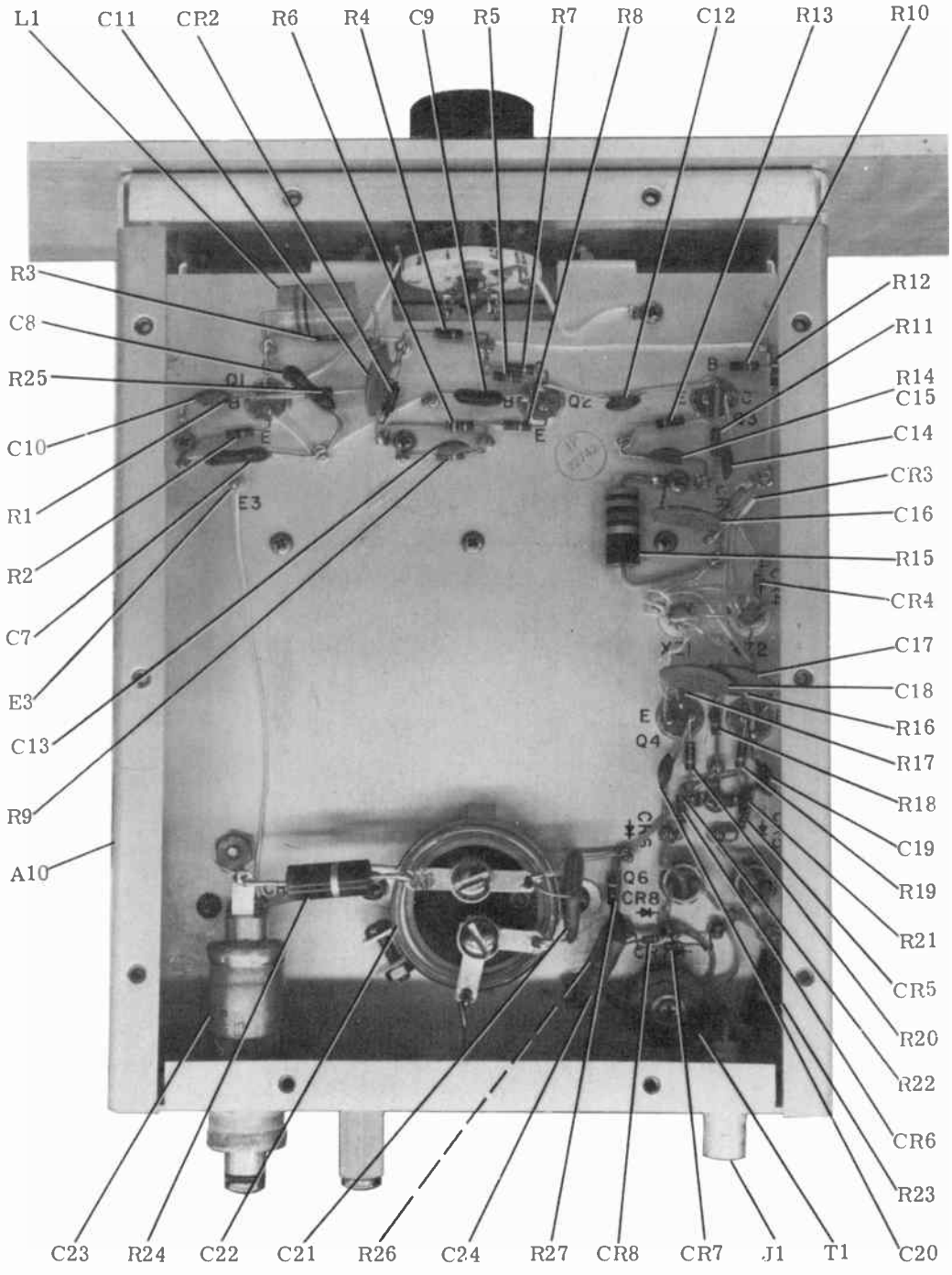

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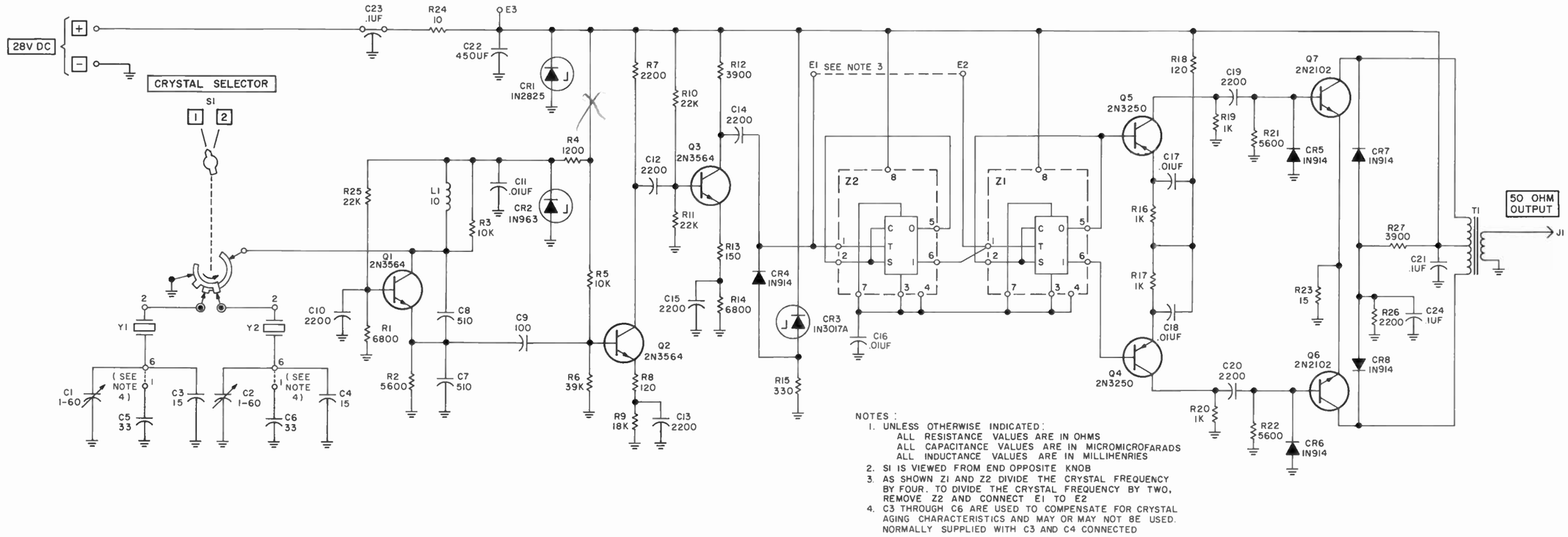
Figure 2. 310W-1 AM Broadcast Exciter, Parts Identification (Sheet 2 of 2).

5. PARTS LIST

SYMBOL	DESCRIPTION	MANUFACTURER'S PART NUMBER	MFR CODE	COLLINS PART NUMBER
	310W-1 AM. BROADCAST EXCITER (WHITE PNL) 310W-1 AM. BROADCAST EXCITER (GRAY PNL) 310W-1 AM. BROADCAST EXCITER (GRAY PNL) 310W-1 AM. BROADCAST EXCITER (WHITE PNL)			758-5207---- 758-5207-003 758-5207-002 758-5207-001
C1	CAPACITOR, VARIABLE 1-60 UUF, 1000 VDCW	MC606Y	73899	922-3038-040
C2	SAME AS C1			
C3	CAPACITOR, FXD, CERAMIC 15 UUF, 5% TOL, 500 VDCW	CC20CH150J	81349	916-0671-000
C4	SAME AS C3			
C5	CAPACITOR, FXD, CERAMIC 33 UUF, 5% TOL, 500 VDCW	338051C0H330J	72982	928-4012-000
C6	SAME AS C5			
C7	CAPACITOR, FXD, MICA 510 UUF, 5% TOL, 500 VDCW	CM06FD511J03	81349	912-2980-000
C8	SAME AS C7			
C9	CAPACITOR, FXD, MICA 100 UUF, 5% TOL, 500 VDCW	CM05FD101J03	81349	912-2816-000
C10	CAPACITOR, FXD, CERAMIC 2200 UUF, 20% TOL, 500 VDCW	19C267A4	01939	913-3011-000
C11	CAPACITOR, FXD, CERAMIC 0.01 UUF, 20% TOL, 500 VDCW	36C175A	01939	913-3013-000
C12	SAME AS C10			
C13	SAME AS C10			
C14	SAME AS C10			
C15	SAME AS C10			
C16	SAME AS C11			
C17	SAME AS C11			
C18	SAME AS C11			
C19	SAME AS C10			
C20	SAME AS C10			
C21	CAPACITOR, FXD, CERAMIC 0.1 UF, PLUS 80% MINUS 20%, 500 VDCW	41C92	01939	913-3152-000
C22	CAPACITOR, FXD, ELECTROLYTIC 450 UF, PLUS 100% MINUS 10%, 50 VDCW	32D1135T	56289	183-1958-000
C23	CAPACITOR, FXD, PAPER 0.1 UF, PLUS 20% MINUS 10%, 600 VDCW	NF1L247	09023	241-0006-000
C24	SAME AS C21			
CR1	SEMICONDUCTOR DEVICE, DIODE	1N2825A	04713	353-1418-000
CR2	SEMICONDUCTOR DEVICE, DIODE	1N963A	04713	353-3220-000
CR3	SEMICONDUCTOR DEVICE, DIODE	1N3017A	04713	353-1312-000
CR4	SEMICONDUCTOR DEVICE, DIODE	1N914	96214	353-2906-000
CR5	SAME AS CR4			
CR6	SAME AS CR4			
CR7	SAME AS CR4			
CR8	SAME AS CR4			
E1	TERMINAL, FEEDTHROUGH	SL276-198D	12625	306-1321-000
E2	SAME AS E1			
E3	TERMINAL, STANDOFF	SL-439-433	12625	306-1521-000
J1	CONNECTOR, ELECTRICAL 1 CONTACT	UG-1094A/U	80058	357-9804-000
L1	INDUCTOR, RF 10 MH, 10% TOL	3500-42	71895	240-0844-000
Q1	TRANSISTOR	2N3564	07263	352-0631-010
Q2	SAME AS Q1			
Q3	SAME AS Q1			
Q4	TRANSISTOR	2N3250	04713	352-0626-010
Q5	SAME AS Q4			
Q6	TRANSISTOR	2N2102	02735	352-0646-010
Q7	SAME AS Q6			
R1	RESISTOR, FXD, COMPOSITION 6.8K OHMS, 10% TOL, 1/4 WATT	RC07GF682K	81349	745-0779-000
R2	RESISTOR, FXD, COMPOSITION 5.6K OHMS, 10% TOL, 1/4 WATT	RC07GF562K	81349	745-0776-000

SYMBOL	DESCRIPTION	MANUFACTURER'S PART NUMBER	MFR CODE	COLLINS PART NUMBER
R3	RESISTOR, FXD, COMPOSITION 10K OHMS, 10% TOL, 1/4 WATT	RC07GF103K	81349	745-0785-000
R4	RESISTOR, FXD, COMPOSITION 1.2K OHMS, 10% TOL, 1/4 WATT	RC07GF122K	81349	745-0752-000
R5	SAME AS R3			
R6	RESISTOR, FXD, COMPOSITION 39K OHMS, 10% TOL, 1/4 WATT	RC07GF393K	81349	745-0806-000
R7	RESISTOR, FXD, COMPOSITION 2.2K OHMS, 10% TOL, 1/4 WATT	RC07GF222K	81349	745-0761-000
R8	RESISTOR, FXD, COMPOSITION 120 OHMS, 10% TOL, 1/4 WATT	RC07GF121K	81349	745-0716-000
R9	RESISTOR, FXD, COMPOSITION 18K OHMS, 10% TOL, 1/4 WATT	RC07GF183K	81349	745-0794-000
R10	RESISTOR, FXD, COMPOSITION 22K OHMS, 10% TOL, 1/4 WATT	RC07GF223K	81349	745-0797-000
R11	SAME AS R10			
R12	RESISTOR, FXD, COMPOSITION 3.9K OHMS, 10% TOL, 1/4 WATT	RC07GF392K	81349	745-0770-000
R13	RESISTOR, FXD, COMPOSITION 150 OHMS, 10% TOL, 1/4 WATT	RC07GF151K	81349	745-0719-000
R14	SAME AS R1			
R15	RESISTOR, FXD, COMPOSITION 330 OHMS, 10% TOL, 2 WATTS	RC42GF331K	81349	745-5631-000
R16	RESISTOR, FXD, COMPOSITION 1K OHMS, 10% TOL, 1/4 WATT	RC07GF102K	81349	745-0749-000
R17	SAME AS R16			
R18	SAME AS R8			
R19	SAME AS R16			
R20	SAME AS R16			
R21	SAME AS R2			
R22	SAME AS R2			
R23	RESISTOR, FXD, COMPOSITION 15 OHMS, 10% TOL, 2 WATTS	RC42GF150K	81349	745-5575-000
R24	RESISTOR, FXD, COMPOSITION 10 OHMS, 10% TOL, 2 WATTS	RC42GF100K	81349	745-5568-000
R25	SAME AS R10			
R26	SAME AS R7			
R27	SAME AS R12			
S1	SWITCH, ROTARY 1 SECTION, 2 POSITIONS	PA602-317	71590	259-2438-010
T1	TRANSFORMER			758-0328-002
XQ1	SOCKET, TRANSISTOR, 4 PINS	3303	91662	352-9872-000
XQ2 THROUGH XQ5	SAME AS XQ1			
XY1	SOCKET, CRYSTAL 8 CONTACTS	7480-0029	94991	220-1121-000
XY2	SAME AS XY1			
XZ1	SOCKET, INTEGRATED CIRCUIT 8 TERMINALS	8058-1G19	91506	352-9560-010
XZ2	SAME AS XZ1			
Y1	CRYSTAL, QUARTZ	BL289-7021-XXX(1)	71034	289-7021-000
Y2	SAME AS Y1			
Z1	INTEGRATED CIRCUIT	SC2239	04713	351-7008-020
Z2	SAME AS Z1			

SYMBOL	DESCRIPTION	MANUFACTURER'S PART NUMBER	MFR CODE	COLLINS PART NUMBER
	MANUFACTURERS CODES			
CODE	MANUFACTURER			
01939	SPRAGUE ELECTRIC CO. GRAFTON, WIS.			
02735	RADIO CORP. OF AMERICA COMMERCIAL RECEIVING TUBE AND SEMICONDUCTOR DIVISION SOMMERVILLE, N.J.			
04713	MOTOROLA SEMICONDUCTOR PRODUCTS INC. 5005 EAST MCDOWELL ROAD PHOENIX, ARIZ.			
07263	FAIRCHILD CAMERA AND INSTRUMENT CORP. SEMICONDUCTOR DIVISION 313 FRONTAGE RD. MOUNTAIN VIEW, CALIF.			
09023	CORNELL-DUBILIER ELECTRIC CORP. ELECTROLYTICS AND PAPER TUBULAR DIVISION 2562 DALRYMPLE SANFORD, N.C.			
12625	SPRAY PRODUCTS CORP. P.O. BOX 1988 CAMDEN, N.J.			
56289	SPRAGUE ELECTRIC CO. NORTH ADAMS, MASS.			
71034	BLILEY ELECTRIC CO. INC. 58 UNION STATION BLDG. ERIE, PA.			
71590	CENTRALAB DIVISION OF GLOBE-UNION INC. 932 E. KEEFE AVE. MILWAUKEE, WIS.			
71895	DELAVAN MFG. CO. 811 FOURTH ST. WEST DES MOINES, IOWA			
72982	ERIE TECHNOLOGICAL PRODUCTS 644 W. 12TH. ST. ERIE, PA.			
73899	J.F.D. ELECTRONICS CORP. 15TH AT 62ND ST. BROOKLYN, N.Y.			
80C58	JOINT ELECTRONICS TYPE DESIGNATION SYSTEM			
81349	MILITARY SPECIFICATIONS			
91506	AUGAT INC. 33 PERRY AVE. ATTLEBORO, MASS.			
91662	ELCO CORP. WILLOW GRAVE, PA.			
94991	SYLVANIA ELECTRIC PRODUCTS WIRE METAL AND PLASTICS PARTS DIVISION WARREN, PA.			
96214	TEXAS INSTRUMENTS INC. APPARTUS DIVISION 6000 LEMMON AVE. DALLAS, TEXAS			



NOTES :
1. UNLESS OTHERWISE INDICATED:
   ALL RESISTANCE VALUES ARE IN OHMS
   ALL CAPACITANCE VALUES ARE IN MICROMICROFARADS
   ALL INDUCTANCE VALUES ARE IN MILLIHENRIES
2. S1 IS VIEWED FROM END OPPOSITE KNOB
3. AS SHOWN Z1 AND Z2 DIVIDE THE CRYSTAL FREQUENCY BY FOUR. TO DIVIDE THE CRYSTAL FREQUENCY BY TWO, REMOVE Z2 AND CONNECT E1 TO E2
4. C3 THROUGH C6 ARE USED TO COMPENSATE FOR CRYSTAL AGING CHARACTERISTICS AND MAY OR MAY NOT BE USED. NORMALLY SUPPLIED WITH C3 AND C4 CONNECTED

B502-007-4

Figure 3. 310W-1 AM Broadcast Exciter, Schematic Diagram.